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EDITORIAL

Efficiency is a word much used in our 20th century vocabulary. Everything in an expanding population, in overcrowded cities where work seems to increase (according to Parkinson's Law?) must run efficiently if there is not to be a considerable wastage of quantities of time, temper and ultimately money. This principle must apply not least to hospital organisation, where the increase of work in an expanding Welfare State is real (and not according to Parkinson's Law!) and for which there is not a limitless supply of all kinds of staff.

Efficiency in hospital administration has recently been reviewed by the methods of Work Study which have long been used in industry. Attention to this matter has probably been stimulated by the sight of endless wage spirals with which the administration cannot cope indefinitely. The Westminster Hospital has been at the forefront of these developments, and according to the principles of Work Study the syringe service was examined: five technicians were employed and their output averaged 500 syringes and needles a day. The work was broken down into 101 "operations" which on analysis could be reduced by 42 (which were shown to be unnecessary operations). The estimated result: the production of 900 syringes and needles; the result in practice was the production of 1,300 a day with a reduced staff of three. The saving: £1,200 recurring annually and £736 from a reduction of syringe stocks.

A figure of this order may seem small, but there are few limits to the expansion of Work Study methods. Langthorne and Whipps Cross Hospitals (totalling 1,950 beds) viewed with dismay the prospect of a 10 per cent wage increase for domestic staff: a Work Study investigation showed an estimated saving of several thousand pounds. At Guy's, the laundry was investigated and among the results achieved was a reduction in the time cycle per machine of 25 per cent. Again, the Westminster Hospital reviewed the state of washing up in their largest nurses' home: this is a process involving many people for hours. Reduced handling of crockery made the procedure quicker and breakages fewer, and with improved equipment resulted in an annually recurring saving of £1,170.

The success of Work Study at the Westminster Hospital has resulted in widespread interest. A most satisfactory outcome is the delegation of authority to Regional Boards to appoint one Work Study officer. While one such officer per region may appear to be little more than an acknowledgement, it is a recognition of the fact that these methods have come to stay. A brief survey of 12 hospitals throughout the country (11 of them

teaching hospitals), chosen at random, has shown what might be considered representative of the interest in this subject. Without exception, they all have some scheme under way, and several already have results. Edinburgh reported that "... there is no doubt that the whole department is much more alive and much more on its toes than it ever has been before ..."

The limitations of the methods must also be realised. Human frailties do not permit man to work like a machine, and there will always be inefficiency and increased numbers of "operations" through forgetfulness and fatigue and for this reason the application of work study must necessarily have a limiting factor.

One has also become aware of the fact, that with increased availability of equipment, for example, there is an increase of usage, and consequent reduction of the apparent efficiency. The example to hand is that of the syringe service already described: production rose considerably, but so did consumption which certainly suggested that now that they are available, more syringes are used than absolutely necessary. In fact, in this case the needles were not always sharp, and this instance provides a warning that quality should not be sacrificed to quantity even for the sake of efficiency.

It is most important, too, that the organisers of Work Study schemes, in hospitals or anywhere else, should always remain aware of the fact that a scheme successful one year may be useless the next. The introduction of new techniques and machines can alter the picture very quickly, and Work Study schemes must keep abreast of such developments, or they will become outdated very rapidly. It can therefore become an extremely expensive occupation in itself and must be organised so efficiently that the cost of the services rendered does not equal or exceed the savings effected by its methods.

Ultimately the methods of Work Study will be extended to a detailed investigation of the ward unit, which is essentially the most important and the most complex unit of any hospital. Already some hospitals have investigated nursing methods: the London for example, was able to introduce the new 44-hour week smoothly and without upset. Following the ward unit, the logical conclusion is the design of efficient new hospitals. Bristol Infirmary has investigated an acute surgical ward in this way, and intend to plan their hospital extension accordingly. It is after all important that the entire space relationships of any building should be governed by the principles of Work Study—which cannot be said for many recently constructed buildings. It is most fortunate that Work Study methods are being established at a time when many major building schemes are being initiated, and it is only a pity that the Ministry of Health cannot be persuaded to take more interest in the opportunities they afford.

One does not need a very acute power of observation to notice where Work Study might be useful. The nurses trail to the Dispensary and wait; the students spend hours walking to the Path. Lab.; the patients spend hours waiting to be seen by students then by doctors; the working of the "coloured" boxes in which apparatus is ill-placed, and instruments in short supply leaves much to be desired. These are just a few instances which spring to mind—there are many others. When will Work Study visit us?

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Another important development of efficiency in hospitals is the introduction of various forms of Call Systems. Some of these are described in an article to be found elsewhere in this Journal.

GENETICS AND MEDICINE

The emphasis of this issue of the Journal is on some of the genetical aspects of medicine. It is important that members of the medical profession should maintain some interest in current genetics which advance with great rapidity. As our knowledge of heredity increases, the possibility of predicting the acquisition of disease is becoming much more frequent; as such predictions become more certain, so a new and very real social problem is going to arise in which married couples wanting children may be

faced with some difficult decisions, and doctors and advisory councils will find it increasingly difficult to give helpful or constructive advice. This may seem rather futuristic, but the trend is rapidly in this direction, and certainly cannot be prevented. It may also be possible that with an increased knowledge of heredity, there may evolve ways of controlling it, indeed one might well expect this to be the case. The first task, however, is to acquaint ourselves with the facts before us.

Fifty Years Ago

A report appears in the Journal of a case of rheumatoid arthritis treated by bee stings. The patient, who was a married lady of 32, had involvment of the wrists, elbows, knees and ankles. There was gross deformity and limitation of movement together with much pain and muscle spasm.

Dr. Herringham, having started the patient on a régime of electric baths, hot douches, massage and carbonate of guaiacol gr. xv t.d., tried the effect of bee stings:

August 26: "I got six bees and made them sting her left knee."

August 31: "Eight stings".

September 3: "Twelve stings, six to each knee . . . from that time she had a dozen bees twice a week until September 18, when I left off under the impression it did no good."

The patient was then put on formic acid injections but on October 1 asked for the bee stings to be started again as she found relief in them, although no permanent improvement resulted.

This appears to be the case already mentioned in these columns as being the subject of concern in the "halfpenny press". It seems that at the time of this case there was a Beekeepers' Exhibition in which an instrument for applying bees was shown and it is thought that the *Daily Mirror* learnt from this source of the use of bees at Bart's: "Anyway, the *Daily Mirror* was about our bed, and spying out all our ways in less than no time, and the Secretary of the Hospital looked at me from under his eyebrows, like Zeus, for he had to answer a sheaf of letters inquiring about it!".

Ruddigore

The Gilbert and Sullivan concert on November 20 was this year produced and conducted by Christopher Hood, and certainly does him considerable credit. If one considers that the basic material which he has had to mould into a chorus is very largely composed of those who on the whole have very little to do with music, the achievement is all the more remarkable. The whole performance was alive and spirited, and presented the audience—which on the whole was rather slow to respond—with a most enjoyable evening. The Gresham Hall was packed to capacity, and one was pleased to see a large number of staff there. It is a pity that more domestic productions of this kind are not seen at Bart's: "G. and S." is all that is left of the many theatrical productions and concerts which used to be seen and heard during each year.

The chorus this year was again a good size (almost 100 strong), but perhaps rather lacking in vitality. The women outnumbered the men considerably, but for all their size the body of sound was disappointingly weak; by contrast, the smaller band of men were much more alive and seemed to have much more control over the music. The balance of the whole was therefore good.

The talents of the soloists—an all Bart's cast—were remarkable indeed. Congratulations must go to Gwilym Michael, singing for the first time at a Bart's concert, for his outstandingly spirited and yet controlled performance as Richard Dauntless. George Hobday as Sir Ruthven Murgatroyd sang with a power and vitality which were even better than last year, and Wendy Roles singing the part of Rose, the village maiden, once again delighted the audience. *In sailing o'er life's ocean wide*, sung by this trio in the first act was one of the highlights of the evening, and deserved more response from the audience than it in fact got. John Creightmore, now familiar to the Bart's "G. and S" productions, sang the part of the wicked baronet, and excellent as his singing was, he was not wicked enough, nor was Mad Margaret convincingly mad as portrayed by Nancy Watts, who has a pure and too gentle voice for a hysterical woman. The Murgatroyd ghost was excellently sung by Nick Roles, and one was sorry not to hear a little more of him—or of Sally Clarke who sang the part of the bridesmaid Zorah exquisitely. David Wells as Old Adam Goodheart sang most competently, and Vanessa Jones in the part of Dame Hannah, after a rather shaky start, found her form in *There grew a little*

flower. The whole production was held together by the talent of Dr. Lehmann who delighted the audience with his inimitable delivery of the story.

The orchestra, larger than ever before, under the able leadership of Sylvia Watkins, accompanied admirably, although there was a tendency (so common among amateurs) to drown the soloists, despite the sometimes audible efforts of the conductor to keep it down. One was pleased to notice that although it was supplemented by outsiders, many of the players were from Bart's.

The evening ended with the traditional party, at which the spontaneous cabaret was quite outstanding.

This same evening, the engagement of Christopher Hood to Alison Clair was announced, and we would like to take this opportunity to congratulate them, and wish them every happiness.

Abernethian Society

"A new approach to diagnosis" was the theme of the lecture given by Mr. de la Warr of Oxford on November 19. A new approach it is indeed. Its basis is the power of mind over matter (a common enough phenomenon), the connection between them being some form of "vibration" of fixed (and empirically determined) frequency. The usefulness of this technique is to be found in diagnosis, in which one can "tune in" to the affected organ, and discover the disease. All that is required of the patient is a specimen of blood, a hair, or a photograph, which is inserted into the machine.

Mr. de la Warr continued to demonstrate the power of mind over matter with a series of photographs apparently made by exposure in the machine to the sample from the patient, and pictures resembling tuberculous lungs or cancerous stomachs made in this way were shown.

The power of the mind to affect cellular multiplication was also demonstrated by series of photographs of plants: the control plants consistently proved to be smaller than those which had been stimulated by thoughts mediated through this "machine".

These ideas are certainly new and strange. One is disappointed to find that systematically planned and controlled scientific methods do not seem to have been employed in many of the experiments. However, it is important that one should have an open mind when reviewing new phenomena, for many important discoveries have been suppressed for unnecessarily long periods because people have taken a dislike to their novelty.

The Harvey Society

On Monday, November 16, the Society enjoyed a rather gruesome lecture given by Dr. F. E. Camps, a Home Office Pathologist, entitled "Greed or too many Women !" The two cases discussed by Dr. Camps were those of Christie and Jack the Ripper. Although the victims in both cases were women the motives behind each group of murders were vastly different: Christie murdered while satisfying his sexual desires, whilst Jack the Ripper appears to have been a complete sadist with no sexual motive at all.

Two interesting medical points arose from the Christie case. All of the bodies were well preserved and as a high concentration of carbon monoxide was found in the blood stream of each victim it appears that this may act as a preservative. Also live spermatozoa were found in the last three victims which means that spermatozoa can live up to nine weeks in an environment with no enzyme action.

In the Christie case the murderer was caught and brought to justice, but the identity of Jack the Ripper still remains a mystery. Dr. Camps suggested that he might have been a member of the London Hospital Staff but it appears that guesses have become rather wild and even a counter espionage Russian spy has been considered.

That Dr. Camps has accustomed himself to the horrors of murder is apparent from his remark that "the only *really* macabre" part of the Christie case was the human femur used to prop up the trellis work in the back garden ! In spite of, or because of this, the lecture was very well received by a large audience.

Christian Union

The first of the main Mission meetings in Bart's was the Lunch-Hour Service on Friday, November 13, addressed by a lively South London minister, The Rev. Brandon Jackson. The body of Bart's-the-Less was full to hear him talk on the claims of Jesus Christ to the ownership of our lives.

The second, on Tuesday, November 17, was equally well attended. The original speaker being unable to come, the noted solicitor, Mr. J. F. Wallace, was invited in his stead. He came willingly and, after a slow, hesitant opening, warmed to his extemporary task.

He took us through his life as a youngster around our age and made us think of the escapisms in which the modern world indulges, and how Christians in particular face up to realities. Very tellingly he spoke of the way he realised his own foolishness in living apart from Jesus Christ and, eventually, had thrown in his lot with Him. In a most challenging way he reminded us that none could sit on the fence, either one is for Christ, and all He stands for, or against Him, being pawns in the hands of Satan. He gave no quarter for the agnostics for, as he said, this in latinised form becomes "ignorami" and who wants to be known as an ignoramus ?

B.J.S.

The Journal

We would like to wish our readers a very Happy Christmas, and a most successful New Year.

We are pleased to be able to present this Journal in the correct month, very nearly back to its schedule. This has been made possible by the very close co-operation of the printers, Messrs. Groves, Brodie and Co., Ltd., of Slough. We hope that the January issue will appear on time.

The omission of a Calendar in this Journal is because the November issue was published only a little while ago and already covers the necessary period.

IN OUR LIBRARY—THE NEW LOOK

by John L. Thornton

When I entered libarianship thirty years ago I found that the requirements for part of the examinations to be passed before one became a chartered librarian included a study of library planning. Apparently it is the ambition of every librarian to design and plan his own library, to arrange the various departments in accordance with generally accepted rules, to provide adequate lighting, heating, furniture and fittings, and to preside over a library attractive in appearance, superior to any other similar building. Unfortunately, few librarians achieve this ambition, and particularly since the war few new library buildings have been erected, modifications and adaptations being the rule. Special libraries are generally housed in buildings devoted to other purposes, so that external planning in relation to site seldom comes within the province of this type of librarian. However, internal planning is most important, and who better than a trained librarian to design and furnish a library ?

Twenty-one years ago I came to Bart's, and at a meeting of the Library Committee suggested improvements in the lighting and heating of the Library. I requested lights in four alcoves where for some obscure reason none had previously been provided, and one over the clock above the fire, around which readers were wont to congregate. A member of the Committee visited the Library the very next day, declared that "they never had lights there when *I* was a student; why should they want them now", and departed. With the aid of a length of wire and the necessary gadgets I proceeded to rig up the light over the clock, which remained in that position until recently.

During the war all the opaque panes of glass in the windows except two were destroyed, and I hoped that clear plate glass might now be introduced. I was informed that the windows had to be reinstated as before, failing which war damage money would not be forthcoming!

Working in the Library for twenty years provided ample time to study the problem of its renovation without destroying its essential character, which dates from the erection of the building in 1879. I visited every medical library of note in this country, and many special and public libraries, looking forward to the day when the turn of our library should come. In official quarters it was always "next"! Eventually plans were prepared, revised, scrapped, and re-made. Work was actually started on June 30, and the Library re-opened on October 5.

The Library was rewired, which made possible the provision of extra lighting units, power points, and a flourescent display over

one end of the gallery, which was extended to cover two new offices, one for the librarian, and the other for library staff. The old desk was removed from the centre of the Library, modernised, extended by means of a counter, and placed near the exit, around the offices. The two radiators in the centre of the room and the two gas fires were removed, to be replaced by five Flexaire heating units. These are heated by hot water, the warm air being fanned out at one end of each unit. Three chandeliers suspended from former ventilating shafts in the centre of the room provide general lighting by means of eight bulbs to each unit, and adequate light for both reading and illuminating bookcases is provided in every alcove, with two fittings over the fireplace. This latter has been cleaned, and an electric fire placed therein as a centrepiece. The clock has been converted to electricity.

All the large tables in the centre of the room have been removed, and the catalogue and current periodical display racks have been placed on the heating units. New lino has been laid in squares of alternate grey and rosewood marbled tiles, which suggests greatly increased width on the ground floor; the gallery floor was covered with sheet rosewood-coloured lino. All the lino was laid on hardboard to deaden noise.

The ceiling was painted in pale grey with the supporting girders in white, and the majority of the oak woodwork was stripped and polished. The opportunity was taken of dusting the books and rearranging certain of these. The current textbooks and reference books, together with the volumes for the past five years of the most used journals, are now located on island stacks just inside the Library.

These alterations obviously entailed great expense, and the refurnishing of the Library was not executed concurrently. We hope to have new chairs throughout the Library, a few study desks, two exhibition cases and certain office equipment in the near future. The Library will then be more comfortable for readers, better lighted and heated, and the provision of extra shelving space will facilitate the better display of the stock.

It is generally agreed that the library premises are a great improvement upon what was previously provided, particularly as regards lighting and heating, although there are naturally criticisms of certain features and

details. One is astonished to discover how many people have ambitions to plan and design libraries. The problems involved are not merely questions of colour and decor, although the aesthetic aspect cannot entirely be neglected. Librarians must be even more concerned with the distribution of lighting; the best use to be made of available space for readers, stock and display; the dimensions of counters, staff rooms and furniture; and space for future growth, as libraries expand at an astonishing rate, mainly by means of annual additions of periodicals. One cannot lightly discard these costly items, which often increase in monetary value as the sets lengthen.

The ideal library has yet to be planned. It must remain a dream in which walls can be made of elastic, furniture and fittings never date or wear out, and every reader has immediately to hand all the information he requires. The librarians' ambition must remain just that—a dream!

THE TEACHING OF PSYCHIATRY AND PSYCHOLOGICAL MEDICINE

*An Extract from the B.M.S.A. Annual General Meeting, November, 1959**

After the results of the 1956 questionnaire into the clinical curriculum had been studied, the seventeenth Annual General Meeting of the British Medical Students' Association directed its Education Officer to investigate the teaching of Psychiatric and Psychological Medicine in Great Britain.

Data for this report, just published, was collected by means of a questionnaire, the factual information for which was obtained as far as possible from official sources at schools, while the student opinion was assessed from discussions either with large groups of students or with as many individuals as possible. Of the twenty-seven medical schools in Great Britain, replies were received from seventeen, among which Bart's was not included.

Eleven schools reported that a course in normal psychology was given, while the pattern of the teaching of psychiatry in different schools varied enormously according to the apparent importance attached to the subject. The most regular feature of the teaching programme was the lecture, but half of the schools indicated that no formal in-patient ward rounds were arranged and attendances at psychiatric out-patient clinics varied between 0 and 26. In no school was a period of compulsory residency in a mental hospital or unit instituted.

The subject matter in the teaching of psychology centred on human behaviour and therefore served to introduce the student to clinical psychiatry techniques. Courses in psychiatry were devised to cover the more common mental disorders, the detail and degree of emphasis on each aspect of the subject depending on the time available for the teaching of psychiatry.

Student opinion as to the value of this teaching correlated closely with the time spent on the teaching. Where only short courses in psychiatry were given, students attached little value to them, while the opposite opinion was expressed by schools where the time given to psychiatric teaching was above the average. However, opinion was unanimous in the need for a more prominent place being given to psychology and psychiatry in medical education.

To every student the part that the mind plays in any disease is a factor with which he must reckon from the start of his training and thereafter as long as he practises medicine. It is recognised that physiology and anatomy are the basis of all medicine yet training in the functioning of the mind, which is often a controlling factor of physical disease, leaves much to be desired. Students recorded their experience of numerous cases of mild neurosis or psycho-neurosis in out-patient clinics and this undoubtedly led to the most outstanding criticism of psychiatric teaching, namely that the basic knowledge had not been provided. The incorporation of the teaching of both normal and abnormal psychology into the preclinical curriculum would prepare the student for the psychiatric teaching he ought to receive throughout his clinical training.

The General Medical Council in their recommendations on the Medical Curriculum in 1957 stated: "Instruction should be given in the elements of normal psychology . . . During his study of all clinical subjects the attention of the student should be continu-

* From a report compiled by Dr. R. N. M. Macsween.

ously directed by his teachers to the importance of the inter-relation of the physical, psychological and social aspects of disease.

These recommendations provide a sound basis for the teaching of psychological and psychiatric medicine. Without prior knowledge of the G.M.C. report, many students supplied suggestions incorporating these recommendations. With these in mind it is interesting to note the principal features of the new course in psychiatry and psychology to be introduced in Sheffield. Ten pyschology lectures will be given to preclinical students by the Head of the Psychology Department and these will be supported by lecture seminars on normal and abnormal psychology, with patients. (One is pleased to note the reintroduction of a psychology course into the preclinical curriculum at Bart's). During clinical training the greater part of the psychiatric teaching will be left to the final two terms when there will be weekly lecture demonstrations in mental hospitals. However, the students' introduction to psychiatry will be made during the introductory course. In the fourth year two social psychiatry seminars as part of the social medicine clerkship will be given and each student will take a clerkship in the Department of Psychiatry, as part of a Neurology-Psychiatric Clerkship, for one month. During both the fourth and sixth years weekly rounds in medical wards by the Professor of Psychiatry, will be held. The only psychiatric teaching in the fifth year will consist of two lectures to students doing midwifery.

With regard to examinations, the 2nd MB physiology paper will contain one obligatory question on psychology and the Professor of Psychiatry will examine with the Professor of Medicine in the final examination.

The "Sheffield Plan" introduces radical changes in the teaching of psychological medicine. Several years must pass before the results can be assessed, but ought the rest of the medical schools to wait for this assessment before bringing their own teaching programme up to date?

J. A. H. BOOTES.

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Change of address

MR. J. C. SPREY-LEVERTON, Cedar House, Barnack, Stamford, Lincs.

ANNOUNCEMENTS

Engagements

BALL—ROWE.—The engagement is announced between Dr. Michael J. Ball and Jacqueline M. Rowe.

CROSFILL—STEWART.—The engagement is announced between Dr. Martin L. Crosfill and Jean Stewart.

DOWIE—BUTTAR.—The engagement is announced between Dr. Lance Newton Dowie and Sine Buttar.

MANSELL—CHARVET.—The engagement is announced between Peter William Anson Mansell and Anne Caroline Dashwood Charvet.

PRICE—WOOLF.—The engagement is announced between Dr. David Glynne Price and Dr. Audrey Joyce Nadine Woolf.

Marriage

TRAPNELL—GRAY.—On November 14, David Hallam Trapnell to Mary Elizabeth Gray.

Births

GRETTON.—On June 20, to Dr. and Mrs. A. Howard Gretton, now of Daysland Alberta, a son (Adrian Ross), brother for Anne and Stephen.

HARCOURT.—On October 22, to Margaret and Dr. Brian Harcourt, a daughter (Jane Elizabeth).

MONKS.—On October 26, to Phyllis and Peter Monks, F.R.C.S., a third daughter.

PAGE.—On November 4, to Elizabeth and Dr. Arthur Page, a daughter (Susan Margaret), sister for Christina.

ROFFEY.—On November 9, to Anne, wife of Dr. Peter Roffey, a son (James Crispin).

ROXBURGH.—On October 25, to Muriel, wife of Robert Roxburgh, a son.

SHAIRP.—On November 4, to Jean, wife of Dr. Brian E. Shairp, a son (David Brian).

SINGER.—On November 9, to Mary and Dr. Geoffrey Singer, a daughter (Claire), sister for Alison and David.

Deaths

BREST.—On November 4, Dr. Simon Brest. Qualified 1925.

RIGBY.—On November 7, Dr. M. N. J. Rigby. Qualified 1894.

SATOW.—On September 29, Dr. Lawrence Lancaster Satow. Qualified 1911.

Research at Bart's

DEPARTMENT OF PHYSIOLOGY, I

Research work in several fields of physiology is in progress at the present moment and it is the purpose of this article to give a brief account of the work being carried out by each member of the staff.

Chemoreceptors

Studies of the cardiovascular reflexes initiated by stimulation of the chemoreceptors situated in the carotid and aortic bodies are being made by Professor M. de B. Daly and Dr. Mary J. Scott. They showed that when the carotid bodies, isolated from the circulation and cross-perfused from a donor animal, were stimulated by hypoxic blood the characteristic reflex hyperventilation occurred in the recipient animal together with variable changes in heart rate. The usual response was tachycardia, but sometimes bradycardia or no change in rate occurred. The cause of these variable responses was that the primary or direct reflex effect on the heart of stimulation of the carotid bodies was a bradycardia, but that this response was often masked by secondary cardioaccelerator mechanisms resulting from the concomitant reflex hyperventilation. These accelerator mechanisms are a stretch reflex from the lungs, being initiated by an increase in depth and rate of respiration, and a lowering of the arterial blood pCO_2

Mechanisms governing the changes in cardiac output (measured by the dye-dilution method) and total peripheral vascular resistance in response to stimulation of chemoreceptors are similar. The observed increase in cardiac output and fall in total peripheral vascular resistance are not the result of a primary reflex from the chemoreceptors, but are secondary to the effects of the accompanying reflex increase in respiration.

The changes in heart rate associated with stimulation of the carotid bodies are the same both in animals breathing room air and in those with induced hypoxia. These results are of interest with regard to the mechanism of the tachycardia occurring in systemic hypoxia produced, for instance, by inhalation of low oxygen gas mixtures because it has been generally assumed that it is the result of stimulation of chemoreceptors. It is evident from the above experiments that this cannot be the case.

Current work is continuing along similar lines. The mechanism of the tachycardia in hypoxia is still obscure because it has been found that it cannot be entirely accounted for by secondary effects of hyperventilation; the response still occurs under conditions of controlled ventilation. The mechanisms underlying the increase in cardiac output associated with this condition are also not yet fully understood.

The fact that emerges from this work is that although under controlled experimental conditions it can be shown that the chemoreceptors exert profound *primary* reflex effects on the circulation, these may be masked under normal conditions by events secondary to changes in respiration. This emphasizes the importance of taking into account effects from accompanying changes in respiration as potential mechanisms determining the observed responses of the cardiovascular system.

Haemodynamics

Other problems concerned with the circulatory system are being investigated separately by Dr. D. A. McDonald and Dr. D. H. Bergel. A study of the pulsatile pressure and flow in arteries is being carried out by Dr. McDonald. The work he has in progress is designed to provide a quantative basis for the analysis of the form of the pulse wave. With the rapid advance in technical equipment since the war efficient manometers are in general use and a large literature has grown up which shows how greatly the form of the pulse wave varies in various parts of the arterial tree and with varying physiological or pathological conditions. There is, however, relatively little agreement as to the cause of these changes, and without an understanding of the underlying physical principles relatively little information can be got from the records compared with the technical skill and effort involved.

The first step in such an analysis is to establish the relationship between pulsatile pressure and flow; the fact that measurement of pulsatile flow is much more difficult than that of pressure is the main reason that better progress has not been made previously. Physiologically it is the flow of blood

that is important and its pressure is only a secondary consideration. Ten years ago few reliable arterial flow measurements were available. Dr. McDonald and his colleagues developed a simple, but rather tedious, method of measuring flow in which bubbles of oxygen were injected into an artery and the rate of travel recorded by high-speed cinematography (a taking speed of about 1,500 frames/sec is necessary). These showed that the pulsatile variations in flow during the cardiac cycle were much greater than were supposed, and even involved a period of backflow in many arteries. They were fortunate at that time to secure the collaboration of a distinguished mathematician, Mr. J. R. Womersley, who derived the theoretical equations relating an oscillating pressure and flow in a tube. This is a general solution related to the well-known Poiseuille formula for constant flow. It is more complicated to apply because with the odd-shaped waves that the heart produces it is necessary to work out the flow for each frequency (or harmonic) component of the wave. However, they were able to show that the pulsatile flow could be predicted remarkably well from the pressure-gradient in an artery. Thus the gradient can be used as a method of measuring flow, without inserting a flowmeter.

The next set of problems were concerned with the behaviour of the waves as they travel along arteries. As blood has a considerable viscosity one would expect the waves to be damped out as they travel. Instead of that it is well-known that the size of the pressure-wave usually increases; for example, the pulse-pressure in the femoral artery may be over 50 per cent larger than that in the ascending aorta and in smaller branches it is larger still. This is due to the reflection of the pulse-wave from sites of branching, and by a series of experiments it has been shown that most of this reflection is in the region where the small arteries divide into arterioles. On present estimates some 30-40 per cent of the wave is reflected under normal conditions and ranges from about 20 per cent with marked vasodilation to 75 per cent with extreme vaso-constriction. One effect of this is that where the pressure pulsation is increasing the flow pulsation is markedly reduced.

The effects of the interaction of waves travelling away from the heart with reflected waves travelling towards the heart are complicated and the great part of this analysis has been due to Dr. M. G. Taylor, who has recently returned to Australia. However, it is possible to express the net result in terms of the "input impedance". This term was borrowed from electricity because the corresponding usage of "peripheral resistance" for the ratio of the mean pressure to the mean flow is so familiar. By analogy, the input impedance is the relation of pulsatile pressure to pulsatile flow, just as one talks of impedance in alternating current circuits. It is rather more involved, however, for the impedance is different for each frequency component of the pulse. To get more precise information from the impedance it is also necessary to know the effect of frequency on arterial elasticity—work which Dr. Bergel has in progress. By applying similar measurements of impedance at the root of the aorta it is also hoped that a satisfactory method of estimating the stroke output of the heart from pulse-wave recording in the proximal aorta can be developed.

Dr. Bergel's work in more detail is as follows. It has long been known that the pulse wave velocity is related to the elasticity of the arterial wall, but that in additon several other factors may be concerned. It is therefore important to know the elasticity of the vessel wall so that the influence of these other factors may be more clearly assessed *in vivo*. It might be thought that such measurements had already been made, but in fact most published work on vascular elasticity cannot be used owing to the absence of important data, for example the wall thickness of the specimen. For these reasons the following work has been carried out.

For a thin-walled tube of radius (R) and wall thickness (h), made of a material with Young's modulus of elasticity (E), the velocity of propagation (c) of a pressure wave is given by the formula:

$$c = \sqrt{\frac{Eh}{2R\rho}}$$

which is known as Moens-Korteweg equation (ρ is the density of the liquid in the tube).

The question arises as to the proper value of (E) to be used in this equation. In common with other substances a piece of artery cannot extend instantaneously when loaded; the internal viscosity of the wall will result in a retarded response. The faster one attempts to stretch such a material the more force will be necessary, that is, it will be stif-

fer, and the further its movements will lag behind the force. The elastic constants of the artery have therefore been measured under both static and dynamic conditions, since the pulse wave itself is a rapid event.

The experiments so far carried out have been on excised specimens, but studies on vessels *in vivo* will be made later. An apparatus has been devised by which simultaneous measurements can be made of the diameter of a vessel and the pressure within it. These quantities are first measured during a very slow inflation to 240 mm Hg and then under dynamic conditions. This is done with a pump which develops small pressure oscillations of 5-10 mm Hg on a mean pressure of 100 at speeds up to 20 cycles per second. In brief the results show that most arteries are considerably stiffer even at 2 cycles per second than when measured statically. The dynamic modulus can be expressed as a percentage of the static and in round figures the average values for the four types of vessels studied are as follows: thoracic aorta 100 per cent, abdominal aorta 120 per cent, femoral artery 140 per cent and carotid artery 160 per cent. This means that the dynamic stiffness increases towards the periphery and would seem to be related to the amount of smooth muscle in the wall, and the actual figures obtained fit very reasonably with the pulse wave velocities quoted in the literature (4-5 metres/sec. in the aorta, which is about half that in smaller and more muscular arteries). The amount of phase-lag between pressure and dilation is remarkably constant in the different vessels and is also quite small, rising to about 10 degrees at 20 cycles per second; this will have the effect of attenuating the propagated oscillations by a small amount.

Literature covering some of the work described in this article may be found in the selected references given below.

(To be continued)

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AID TO PHARMACY

When Dilling made his novel law,
He overlooked a tiny flaw,
So Evans in his helpful way
Modified it thus to say—
An infant's need is very close
To the product of the adult dose
And child's next birthday age plus four,
Divided by, for luck, a score.
Though Evans had his share of fame,
The law still carries Dilling's name.

Capricorn.

ANIMAL FARM or DUCK EGG BLUES ?

Professor G-rr-d: We have all I suppose, been quacks at some time in our lives.
Dr. Sh--t-r: I can't pass duck eggs.

* * * *

INFLAMED WITH DESIRE

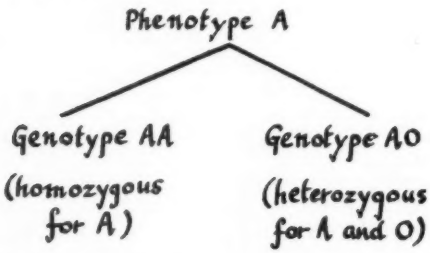
Kekulé . . . abandoned architecture for chemistry after hearing Liebig give evidence at an inquest on a hard-drinking countess whose death had been ascribed to spontaneous combustion.
(from the Proceedings of the Chemical Society, October, 1959.)

The Chemistry of Inheritance

"ONE GENE, ONE POLYPEPTIDE CHAIN"

by H. Lehmann

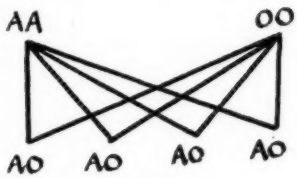
The discovery of sickle-cell haemoglobin (haemoglobin S) by Linus Pauling and his colleagues has been a most important step in the scientific progress of the 20th century. Of its many important aspects, not the least is the light it has thrown on the inheritance of a character determined by a single Mendelian gene. It has usually not been possible to know without study of the family whether a person who showed a dominant character was heterozygous or homozygous for the gene determining his character. For instance, it is not possible to say whether a person with blood group A is homozygous or heterozygous for the blood group A gene. The reason for this is that a person's phenotype may be different from his genotype. The phenotype A is what we see, i.e. it comprises those inherited characters which find expression in the living individual. The genotype comprises the genes a person has inherited, and which he can transmit to the next generation. It is not necessary that all these genes find expression in the phenotype. Thus, if a person has blood group A, this phenotype A may be associated with the genotype AA or AO respectively. If inherited with the gene for blood group O, one gene for blood group A can do the work of two.



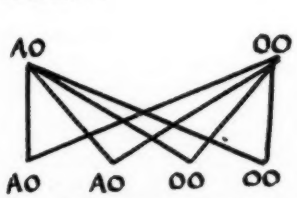
The Phenotype for blood group A may be based on either one of the two genotypes

Only family study can decide which of the two possible genotypes, AA and AO, is responsible for the phenotype A. For example, if a person with blood group A is married to one with blood group O and they have only blood group A children, it is likely that he is homozygous for the A gene. If, however, some of the children have blood group A and some have blood group O, he must be a heterozygote, possessing genes for both blood group A and blood group O. Similar considerations apply to the inheritance of the abnormal haemoglobins. Most adults only possess normal adult haemoglobin—haemoglobin A. These people are homozygotes for the gene controlling the production of haemoglobin A. There are some people who possess two adult haemoglobins, for example, the normal A and the abnormal sickle-cell haemoglobin—haemoglobin S.

In the case of the sickle-cell gene it had been recognised by clinicians that there were two distinct phenotypes, both possessing the gene for sickling, those who were healthy, and those who suffered from the disease of sickle-cell anaemia. Family studies carried out independently by J. V. Neel in America, and by E. A. Beet in Northern Rhodesia had made it likely that sickle-cell anaemia was the homozygous state, and that the symptomless sickle-cell trait was the heterozygous condition. These conceptions were put on a firm biochemical basis when sickle-cell haemoglobin was discovered. Pauling and his associates showed that the sickle-cell anaemia patients were indeed free from haemoglobin A—the normal adult haemoglobin—and that the sickle-cell trait



I. Genotype AA (homozygous). All the children have blood group A



II. Genotype AO (heterozygous). Not all the children have blood group A, therefore the A parent must be a heterozygote

carriers possessed both normal adult and sickle-cell haemoglobin. It was thus possible to make a genotype diagnosis in the laboratory without a family study.

For practical purposes, this diagnosis of a genotype by examining the blood of a sickler for the presence or absence of haemoglobin A came to grief because of the existence of a gene which can cause suppression of the production of haemoglobin A, but not of haemoglobin S. This gene, the thalassaemia gene, can be inherited together with haemoglobin A, and the resultant condition, sickle-cell thalassaemia, may show an absence of haemoglobin A although a gene for this pigment is present. The phenotypes of the sickle-cell homozygote and of the heterozygote for haemoglobins S and A who have also inherited the thalassaemia gene may therefore be virtually identical.

Haemoglobin S was discovered by electrophoresis. In this technique, proteins are dissolved in a buffer solution, and an electric current is passed. When the pH is alkaline, the protein will then move towards the pole carrying the positive

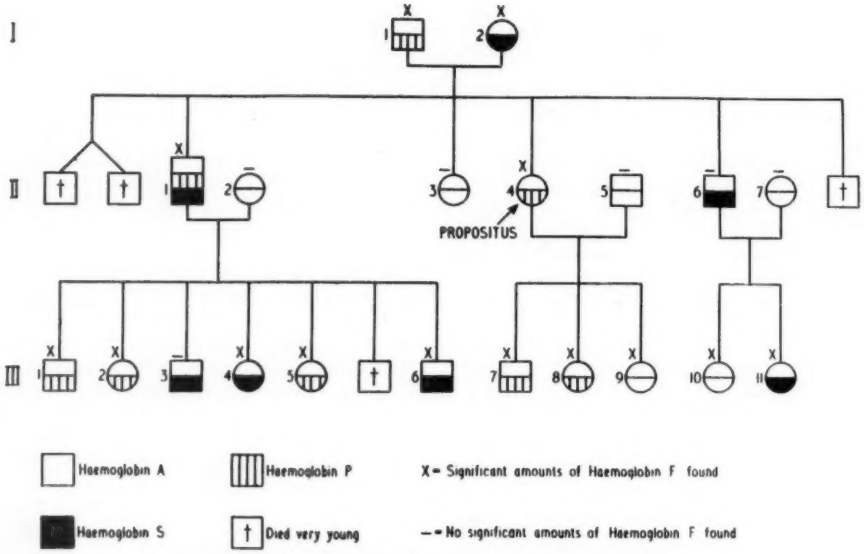
Electrophoretic pattern in Haemoglobin C Disease.
Patient (CC) middle, parents (AC) either side.

charge, and the speed of its movement will depend on the over-all charge of the particular protein. Haemoglobin S is less positively charged than haemoglobin A and will, at a pH on an alkaline side of this iso-electric point, move more slowly towards the positive pole

By the technique of electrophoresis, haemoglobin S and numerous other abnormal haemoglobins, D, E etc. were discovered. Nearly all of them were inherited on strict Mendelian lines, just like the sickle-cell haemoglobin, but there were some exceptions. Foetal haemoglobin did not fit in the pattern of inheritance of adult haemoglobins. It is present at birth, and normally disappears in the first months of life. It cannot be controlled by a gene situated at the same locus of a chromosome which is occupied by those for haemoglobins A, S, and C. These haemoglobins are "allelomorphs", because they are inherited characters controlled by allelic genes, i.e. by genes which, though different from each other, occupy the same locus of a chromosome. One chromosome can carry only one of these genes, and two chromosomes no more than two. As the chromosomes are inherited in pairs, one from each parent, an individual cannot have more than two allelomorphic characters. As foetal haemoglobin is found in addition to haemoglobins A and S, or A and C, or S and C, or in homozygotes for A, S, or C, the gene responsible for its production cannot possibly occupy the same locus as the A, S, C genes. Haemoglobin F is, in fact, chemically quite different from all the adult variants. It has a different ultra-violet spectrum, it is more resistant to alkali denaturation, and whereas the adult variants cannot be differentiated by immunological methods, antisera can be prepared which specifically precipitate either the adult haemoglobins, or foetal haemoglobin. Not all the adult haemoglobins, of which there are now some two dozen known, are allelomorphs of S and C. With colleagues from the Congo, we studied a family where three adult haemoglobins were present in one person, namely haemoglobins A, S, and P. Thus, P and S cannot be allelomorphs. (see family tree, p. 331) Similar observations have been made by Neel and his colleagues, as well as by some workers in Baltimore and in North Africa, which already suggested that there was more than one gene responsible for adult haemoglobin.

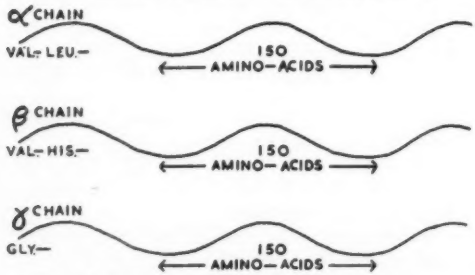
New light has been thrown on the genetical relationship of human haemoglobins by the study of the haemoglobin molecule, largely by Ingram in Cambridge, and Schroeder in California, and their associates.

Horse haemoglobin is an ellipsoid of the following dimensions: 55 x 55 x 70 Angström Units. Human haemoglobin is thought to have a rather similar shape, with a mole-



A family with the adult haemoglobins A, S, and P.

cular weight of 66,700. X-ray crystallographic studies have shown that the molecule is composed of two equal parts, symmetrically arranged. In each half molecule there are approximately 280 amino-acids each arranged in two polypeptide chains α and β. Haemoglobin S differs from haemoglobin A only by one amino-acid; one glutamic acid in haemoglobin A is replaced by a valine in haemoglobin S. The loss of the positive charge associated with glutamic acid, and not present in the neutral valine, explains the difference in electrophoretic behaviour of the two haemoglobins. In haemoglobin C, the same amino-acid is replaced by lysine. Other haemoglobins are substituted at different places of the same β- or α-chain. Haemoglobin F has either the α-chain as haemoglobins A, S, C and so forth, but the other chain is quite different from the β-chain of adult haemoglobin. The difference is so marked that this chain of foetal haemoglobin has been named γ-chain. It is now possible to understand why the differences between haemoglobins A, S, C, and so forth cannot be picked up by immunological methods. They involve only one of some 280 amino-acids. But, in the case of foetal haemoglobin, at least one-half is entirely different from adult haemoglobin. The change-over from foetal haemoglobin to adult haemoglobin is the change from combining the α-chain with the γ-chain to combining it with the β-chain.



The three polypeptide chains of human haemoglobin

One molecule of globin contains four chains

Normal adult haemoglobin	$=\alpha_2\beta_2$
Normal foetal haemoglobin	$=\alpha_2\gamma_2$
Haemoglobin H	$=\beta_4$
Haemoglobin Barts	$=\gamma_4$

Ingram has proposed that adult haemoglobin production is controlled by two genes rather than one, one gene responsible for the α-chain and the other responsible for the β-chain. This would explain that haemoglobins S and C are allelic. One cannot possess haemoglobins A, S and C together, because one can only inherit two β-chain genes from one's two parents. If, for example, one of these is that for a normal β-chain the other can only be one of the other possible

β-chains—A, S, C etc. There is no room for three types of β-chain. On the other hand, if one inherits from one parent an adult haemoglobin with an abnormality of the β-chain, and from the other parent a haemoglobin with an abnormality of the β-chain, one should be able to produce three haemoglobins, or even possibly four. In the case of the family (see family tree) where one individual possesses three different adult haemoglobins, namely A, P, and S, this could be explained if, unlike in haemoglobin S, when the abnormality is in the β-chain, that of haemoglobin P was in the α-chain. In this particular instance, the man with the three haemoglobins would then have inherited a normal β-chain and an abnormal α-chain with haemoglobin P, and a normal α-chain and an abnormal β-chain with haemoglobin S. He could thus form his three adult haemoglobins P, S, and A as follows:

abnormal α-chain + normal β-chain = haemoglobin P

normal α-chain + abnormal β.chain = haemoglobin S

normal α-chain + normal β-chain = haemoglobin A

There seems to be, in this case, no combination of abnormal α-chain + abnormal β-chain.

An entirely different type of haemoglobin abnormality has recently been elucidated. The abnormal adult haemoglobin H did not fit in with the other adult variants. It was not inherited in strict Mendelian fashion. It has now been shown, by Schroeder and his colleagues, that haemoglobin H is in fact normal adult haemoglobin without the α-chain. People with haemoglobin H produce more β-chain than α-chain and have, therefore, in addition to haemoglobin A (α + β), sufficient β-chain left over to form a pure β-chain haemoglobin by itself.

An abnormal foetal haemoglobin was discovered at St. Bartholomew's Hospital, and therefore called haemoglobin Bart's. It is now known that this abnormal foetal haemoglobin is not rare, and occurs fairly frequently in Chinese and Siamese. For instance, in a recent survey of 415 specimens of cord blood from Bangkok, 5 per cent showed haemoglobin Bart's. This pigment is now known to be a pure γ-chain haemoglobin. It is, therefore, an exact foetal counterpart of haemoglobin H. A family has been studied recently, in collaboration with Dr. Ramot and her colleagues in Israel, in which in two members, a mother and her daughter, haemoglobins H and Bart's occurred together. This suggests that there exists a gene which suppresses the formation of the α-chain and causes a surplus of the two others.

Most of our present knowledge on the biochemical genetics of pigments has been derived from plants, but one can truly state that the discovery of the sickle-cell haemoglobin by Linus Pauling, and its chemical analysis by Ingram, have called forth an advance in the studies of human protein which widens, or possibly overtakes, the progress made by the plant biochemists.

Family Histories

SOME OBSERVATIONS MADE IN GENERAL PRACTICE

by L. S. Castleden

The other day a colleague interested in the treatment of infertility wrote to me about an old patient of mine who had moved into his area and sought his help. The gynaecologist said that the girl had mentioned that five of her brothers had died of an obscure disease when quite young—was this disease a familial one?

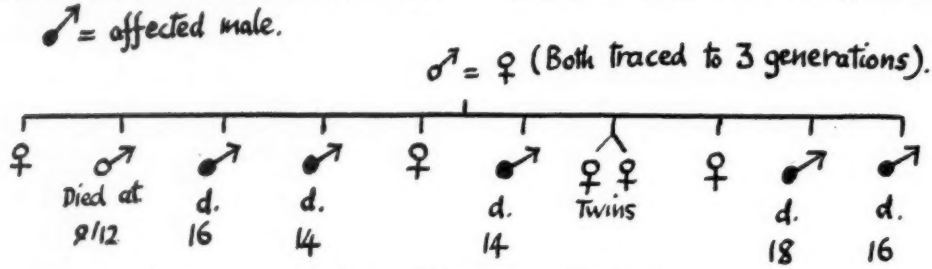
I had no difficulty in recalling the family. I remembered calling to see the last two of these boys some ten years ago. Propped up in a corner of the room were two pathetic paralysed and distorted figures. They were unable to feed themselves or do anything except talk and swallow with difficulty. The boys were then aged 16 and 18 years. Three other brothers were already dead at ages 16, 14 and 14 years and the survivors, being fully intelligent, realised their position. The five sisters were unaffected.

In all cases the history was the same. At the age of 6 or 7 the boys, previously healthy, noticed that they could not climb stairs or ladders. In two cases they had fallen in the school playground and sustained fractures—femur in one case and humerus in another. There was evidently not much actual pseudo-hypertrophy noticed. Quite rapidly wasting

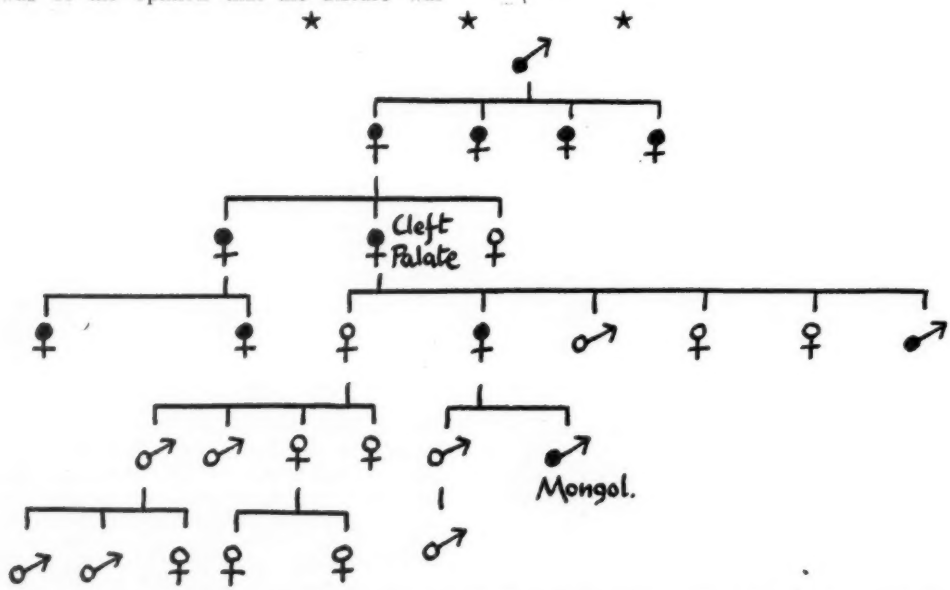
of the calves and thighs became marked. At the same time the muscles of the upper arm and shoulder became wasted. The growth of both upper and lower limbs was retarded and as different muscle groups were stronger than others the bones became distorted. The ribs also were pulled upon by the diaphragm, which was the latest muscle to be affected, so that their thoracic cages were grossly distorted. The two patients I knew died of bronchopneumonia and choking respectively within a few months.

One of the boys was seen at Bart's by Dr. Hinds Howell who was then neurologist. He was of the opinion that the disease was pseudohypertrophic muscular dystrophy.

An attempt was made to discover if any of the family had been affected in previous generations. Both grandparents were alive and could recall their own grandparents' families. In neither case were any further cases brought to light and no cousins were affected. It was considered, however, that there was likelihood of the male children of the girl members of the family exhibiting the disease and they were warned of the risk to their children. So far none have borne children and treatment of the girl with infertility was not pursued.



Is this a newly occurring mutation?



In the case of an abnormality apparent at birth such as web fingers, a family tree can be pretty rapidly compounded. In the above family it will be noticed that two of the affected persons have other developmental defects. The unaffected persons do not appear to pass on the defect.

Genetical Aspects of Psychiatry

by LINFORD REES

In the past prolonged but fruitless controversies were centred on whether particular diseases were determined either by heredity or by environmental influences. This "either/or" concept of the role of nature and nurture in the causation of disease has now been replaced by the modern concept of complex interrelationships and interactions between genetic and environmental factors. It is, indeed, rare to find that either heredity or environmental factors are alone determinative in mental disorders.

Genes produce their effects by controlling enzyme actions and biochemical processes in the body and their actions cannot be considered in isolation as they are influenced by the external environment, the "milieu interieur" of the body as well as by other genes, which are referred to as modifying genes. The pathogenic actions of genes need not always be manifested fully, the tendency for a gene to become manifest being referred to as its expressivity. Some genes have high expressivity, such as Huntingdon's chorea, whereas other genes will only produce observable effects with an appropriate outside stimulus or a special environment in the absence of which the manifest effects of the gene may be entirely suppressed.

Different modes of inheritance are found among mental disorders, some are transmitted by single dominant genes, others by single recessive genes and others by many genes (i.e. multifactorial or polygenic inheritance). A single recessive gene is clinically dormant, whereas a single dominant gene is clinically manifest. In dominantly transmitted disorders, only one parent need be affected, whereas in recessively transmitted disorders, both parents, who themselves may be free from the disease, contribute to the transmission of the disorder to their offspring.

It is a common error to assume that the discovery of genetic causation as a part factor in the development of psychiatric illness will paralyse therapeutic activity. This is far from being true and, in fact, its converse may apply. The discovery of the biochemical correlates of genetically determined disorders is in its early infancy but already the effective control of abnormal metabolism in certain forms of mental deficiency (such as that associated with phenylketonuria and galactosaemia) allows the child's development and growth to proceed normally. If future research reveals the precise nature of the underlying biochemical basis of genetically determined mental disorders, it would open up exciting new possibilities of more effective methods of treatment and prevention.

Methods used in Genetic research

The role of heredity in the causation of psychiatric disorders is not a matter of personal opinion or conviction but one of evidence as in any other science.

In the past the main method used for studying heredity was the investigation of isolated family pedigrees. This method, however, is only suitable for marked abnormalities transmitted by dominant genes with a high penetrance and is quite unsatisfactory for genetic studies of common disorders.

Two main methods are nowadays used for investigating the inheritance of common illnesses.

(1) The statistical - genealogical - proband method of WEINBERG *(1931).* This method consists in taking a random sample of patients suffering from the disease to be studied genetically (referred to as probands) and the incidence of the disorder ascertained in their relatives. This is then compared with the incidence of the disease in the relatives of normal probands of similar age and sex distribution. If the results show a statistically significantly higher incidence of the disease among the relatives of the disease probands than among the relatives of the normal probands, it is highly probable that the disease is due to inherited factors, in the absence of exogenous differences between the disease probands and control probands.

(2) Twin studies. Genetic twin studies are based on the fact that the genetic equipment of uniovular twins is the same so that any differences found between twin pairs are considered to be due to environmental influences. Binovular twins, on the other hand, have different genetic equipment so that any differences found between twin pairs may be due to heredity and/or the environment. The existence of a trait or disorder in both mem-

bers of twin pairs is called concordance. A high concordance rate indicates an hereditary factor.

Let us now consider the results obtained by these methods of research in specific forms of mental illness.

Schizophrenia

Convincing evidence that Schizophrenia is inherited is provided by statistics indicating that the chance of developing the illness increases strictly in proportion to the degree of blood relationship to the schizophrenic proband. The morbidity risk for Schizophrenia in the general population is about 1 per cent. The morbidity risk for different categories of relatives of schizophrenics is as follows: first cousins 2 per cent, grandchildren 3-4 per cent, nephews and neices 3 per cent, parents 5-7 per cent, siblings 5-15 per cent, children 7-16 per cent, dizygotic twins 14 per cent and monozygotic twins 86.2 per cent.

STROMGREN (1938) and KALLMAN (1938, 1953) consider the inheritance of schizophrenia to be by a major recessive gene, the penetrance or expressivity of which varies, being affected both by modifying genes and environmental factors such as unfavourable family circumstances, emotional stresses, pregnancy, intercurrent disease and loss of weight. KALLMAN found, in monozygotic schizophrenic twins, that when one twin remained completely free of schizophrenic symtoms there were differences in physical health and body weight from early childhood consistently in favour of the normal twin. Concordant monozygotic twins of similar body build tended to have the same form of schizophrenia which developed practically at the same time and had a similar outcome, but when there were differences in body type, there were usually differences in the time of onset as well as the clinical picture.

Some authorities, however, favour a dominant mode of transmission with weak penetrance.

Although the evidence is conclusive that schizophrenia is genetically determined it cannot yet be regarded as established whether the mode of inheritance is dominant or recessive.

Affective Disorders

It will be necessary to consider separately, manic depressive psychosis, involutional melancholia and reactive depression.

There is considerable evidence to support the belief that both manic depressive psychosis and cyclothymic temperament are determined by the same gene. An excess of cyclothymic individuals are found in the families of manic depressives, the basic personality of the manic depressive is often markedly cyclothymic and both manic depressive patients and cyclothymic persons tend to have a broad or eurymorphic type of physique (REES, 1957). The theory put forward by SLATER (1936) that manic depressive psychosis is determined by a single dominant gene of weak and variable expression has gained most support. It has been shown that the risk of developing manic depressive psychosis increases proportionately with the degree of blood relationship to the manic depressive patient. The morbidity risk in the general population is about 0.4 per cent, in half siblings 16.7 per cent, full siblings 23 per cent, dizygotic twins 26.3 per cent and monozygotic twins 95.7 per cent.

Involutional melancholia is considered by SLATER (1953) and KALLMAN (1958) to be genetically distinct from manic depressive disorders and genetically more closely related to schizophrenia. With regard to reactive depressions and neurotic depressions there is no evidence that heredity plays an important role in their aetiology apart from indirectly determining type of personality makeup which may be conducive to development of this type of depression.

Organic states

The work of SJOGREN, SJOGREN and LINDGREN (1952) indicates that a single dominant factor was the most likely mode of transmission in Pick's disease whereas polygenic inheritance is probable in Alzheimer's disease. It was found that Pick's and Alzheimer's forms of presenile dementia were more common than usually realized and constituted about 10 per cent of all senile and presenile psychoses with a morbidity risk of 0.1 per cent in the general population.

The work of MJONES (1949) has clarified the heredity basis of paralysis agitans. His results indicate that the mode of inheritance is probably a single dominant gene with a manifestation rate of 60 per cent. Huntingdon's chorea is transmitted by a single dominant gene with such a high manifestation rate that practically every person possessing the gene will develop the disorder if he lives long enough. A person carrying the gene of Huntingdon's chorea will transmit it to

approximately half of his children in accordance with Mendelian laws.

Dominant genes arising from mutation which result in morbid conditions are usually doomed to extinction because the individuals bearing them are rendered infertile by the disease itself. This unfortunately does not apply to presenile dementia and Huntingdon's chorea because of the late age at onset which makes it probable that they will already have had children before developing the disease themselves.

Epilepsy

The results of twin studies provide strong evidence of the importance of heredity in the aetiology of epilepsy, e.g. CONRAD (1937) found that the concordance rate in uniovular twins was 67 per cent rising to 86 per cent if the idiopathic epilepsy only was considered. Further support of genetic factors in epilepsy is provided by electroencephalographic studies. LENNOX, GIBBS and GIBBS (1939, 1940, 1945) found that electroencephalographic abnormalities were very similar in epileptic uniovular twins.

Mental Deficinency (Oligophrenia)

It was shown by ROBERTS (1950) that oligophrenia, considered in terms of intelligence quotient, fell into two distinct categories, with a line of demarcation occurring at an I.Q. of 50. He found that, above this level, were the high grade (feeble minded) defectives who represent the lowest part of the normal frequency distribution of intelligence in the general population. In oligophrenia of this type the mode of inheritance was multifactorial (polygenic) as for intelligence generally in the population. Below an intelligence quotient of 50, ROBERTS (1950) found defectives who could not be accommodated into such a scheme and that in these the mode of inheritance was by means of single major genes. ROBERTS (1952) provided further evidence supporting this hypothesis, and he found that the correlation of intelligence between siblings of feeble minded defectives was +0.5, which is the value for the general population whereas in low grade defectives the correlation was practically zero. The siblings of low grade defectives are either low grade defectives which were in the minority or of relatively normal intelligence which applied to the majority.

Some clinical forms of oligophrenia are transmitted by single recessive genes and others by single dominant genes. The following are examples of those transmitted by single recessive genes: phenyl-pyruvic oligophrenia, late amaurotic idiocy, gargoylism and oligophrenia associated with galactosaemia. The following are examples of oligophrenia transmitted by dominant genes: tuberose sclerosis and oxycephaly.

The aetiology of mongolism has for many years been a controversial subject. The possible operation of genetic factors is indicated by the familiar occurrence of mongolism and the presence of signs which could be abortive forms of mongolism in otherwise unaffected close relatives of mongols. PENROSE (1951) suggested the possibility that the constitutional susceptibility of a foetus to mongolism could be due to a single very common gene the manifestation of which being largely controlled by factors due to maternal age which has been firmly established to be a very important factor in the aetiology of mongolism.

Using new cytological techniques it has recently been found that mongolism is associated with a small extra chromosome as shown by the work of LEJEUNE et al (1959) and FORD et al (1959).

Personality, Character and Neurosis

Animal breeding experiments have provided strong evidence of a genetic basis of behavioural characteristics in mice, rats, dogs and rabbits, particularly differences in aggressiveness, emotional stability and temperament (GINSBERG 1954, HALL 1951, FULLER 1953). A full review of the literature on the role of genetic factors in determining human personality traits is provided by DAVID and SNYDER (1951). EYSENCK (1956) investigated 52 pairs of identical twins by means of tests of intelligence, personality and autonomic nervous system functions. Three main factors were found, relating to intelligence, autonomic lability and to extraversion/introversion, all of which differed significantly between groups of uniovular twins compared with binovular twins the greatest difference being the factor of extraversion which EYSENCK (1956) considers to be determined by heredity to as large an extent as intelligence.

SHIELDS (1958) compared uniovular twins brought up apart with those brought up together and found that uniovular twins often showed significant similarity in important aspects of personality even when they had been brought up apart from an early age by

mothers of quite different character. This finding disproves the contention made by some that identical twins are only similar in personality because they are brought up in the same environment and exposed to the same parental attitudes.

Strong evidence of the inheritance of neurosis was provided by the work of BROWN (1942) who investigated the familial incidence of neurosis in the relatives of groups of probands suffering from anxiety states, hysteria and obsessional states and found it significantly higher than of relatives of a corresponding normal control group. EYSENCK and PRELL (1951) studied groups of uniovular twins, binovular twins and neurotic children of the same age by means of objective personality tests. Statistical analysis showed that about 80 per cent of individual differences in neuroticism was due to heredity and about 20 per cent to the environment. SHIELDS (1953) found that uniovular twins were twice as likely as binovular twins to have the similar degrees of difficulty in adjustment.

Thus all these studies indicate that genetic factors are important in determining in part, personality characteristics and the predisposition to neurotic illness.

General conclusions

During the past twenty years research into the inheritance of psychological attributes and specific mental disorders has steadily become more comprehensive and exact with important contributions arising from the use of mathematical-statistical methods for genealogical population and twin studies.

During the past decade, genetic-statistical population studies particularly in the Scandinavian countries, have yielded important data on the prevalence of mental diseases and mental deficiency in the normal population, and their morbidity risks. Studies of genetically determined metabolic disorders associated with mental deficiency, such as phenylketonuria and galactosaemia, have led to the development of methods of correcting these abnormalities with the striking result that development then proceeds normally. This is a pointer to future possibilities when the underlying biochemical basis of genetically determined psychoses are elucidated.

The results of genetic research should be co-ordinated with those derived from other research methods, such as biochemical, neurophysiological, neuropsychological, psychodynamic and social as stressed by SJOGREN (1957). Such multidisciplinary co-ordinated research would provide the best chance of discovering relevant data for the discovery of new and effective methods of treatment or prevention of psychiatric illness.

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Hospital Call Systems

A SURVEY

Work study (the subject of the Editorial in this issue) is not confined to the investigation of movement, but also involves the replacement of outdated apparatus or systems of communication. The introduction of elaborate systems for staff location in many hospitals is an indication of the awareness of this need.

The present trend for hospitals to be centralised, and therefore larger, and including more departments, makes it increasingly difficult for staff to be located. From a hospital without any means of communication to supplement its telephone system, one is in a very good position to review the systems used elsewhere. It is still just debatable whether any supplementary system is desirable at all in a compactly designed hospital such as our own, where the greatest distance is from the wards to the Pathology Lab. The house staff are still unmolested by bleeps, or worse,a voice speaking from his pocket, and can always refuse to answer the telephone if it is inconvenient. They are not yet caught up by the buzz of 20th century efficiency which could be seriously detrimental to the medicine they are supposed to practise.

The other impression which one receives from reviewing the various systems is that with increased accessibility, the number of unnecessary calls must rise considerably, in much the same way as the usage of syringes increases as they become more abundantly available. The nuisance value in this respect must be considerable, and quite unavoidable.

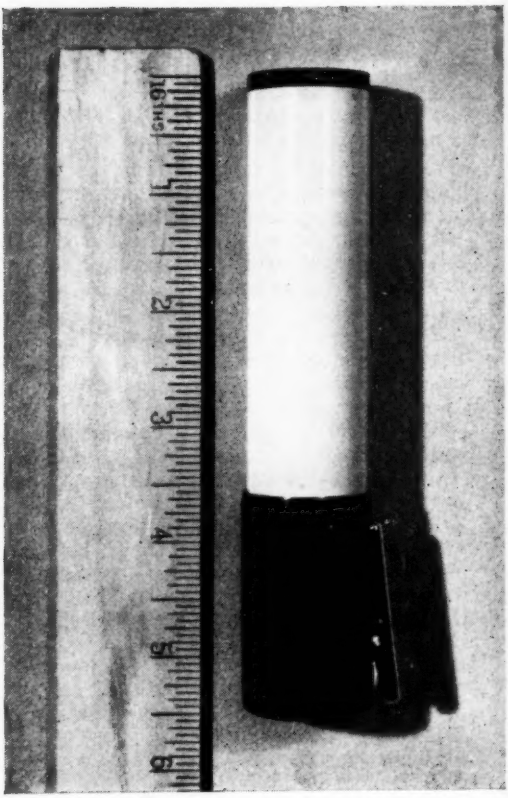
From the other point of view countless hours of frustrated telephoning and searching are spared to the caller, and for this reason these modern systems are becoming inevitable. Even at Bart's, where there is no sign of adoption of any of these systems, the extension of the Hospital to the other side of Little Britain must sooner or later demand the introduction of one or other of the systems now available. It is interesting to observe that Bart's once had a call system, the relic of which is to be seen in every ward, and which is still used to call the night sisters. It limited its call to the duty officers of the day, but it seems that it was abandoned after only a few years' use. After all, the chances are that if the duty house officers are in a ward at all, they will be in their own ward, which makes such a system of very limited value.

The survey already described (Editorial) on the subject of Work Study was extended to the subject of Call Systems: the results were most interesting, and in general showed a trend towards the adoption of the new magnetic system recently developed by St. Thomas' Hospital in conjunction with Messrs. Multitone. Statistics from questioning only 12 hospitals can hardly be considered of great significance, but certainly they are of interest. It was found that four were using a loudspeaker system which is generally regarded as unsatisfactory; while it has the advantage of being universally audible, this is outweighed by considerable nuisance value to both staff and patients, although Cambridge report that when it was introduced at Addenbrooke's the patients even enjoyed the distraction it afforded. All four hospitals are changing to the Multitone system.

Another four used a flashing light system, usually involving four coloured lights. Opinions about the efficacy of this method of calling vary: The Royal Berkshire Hospital, Reading, consider it completely satisfactory; Guy's found it reasonably effective, but two others were dissatisfied. The chief objection is that siting at strategic points which will not at the same time be a nuisance is extremely difficult. Two of these hospitals are changing to the Multitone system.

The remaining four hospitals were St. Thomas', who formerly used a system of bells which rang out a code for each person to be called; the Radcliffe Infirmary at Oxford had a similar system, but operated on buzzers and believed to be unique; Edinburgh, who like ourselves, have no system to supplement telephones are also hoping to follow the example of St. Thomas' in adopting the Mulitone system ; and the Westminster who originally used only telephones (which they found grossly unsatisfactory) have already done so.

In all ten of the twelve hospitals questioned have changed or are hoping to change to the Multitone system. This hardly requires any introduction. Those to be called



Above: the Radiopage receiver used at the London Hospital transmits the spoken message. (Photograph by kind permission of the British Communications Corporation Ltd.).
Right: the Multitone receivers (first used by St. Thomas' Hospital) operates on 50 frequencies. (Photograph by kind permission of "The Hospital").

hear the "bleep" on the pocket receiver shown in the photograph. These operate on 50 frequencies, and if more than this number of people are to be called, simple codes can be arranged.

They weigh only 6 oz. and can be dropped from 6 feet on to concrete without being damaged. They were inaugurated at St. Thomas' on 28th June, 1956. The system obviates all the disadvantages of the older systems such as noise, and difficulties of siting or coding complications. It has been adopted by almost 50 hospitals, as well as by businesses, industries and large hotels.

Another form of the same system carries the spoken message: the receiver shown here is used at the London Hospital. It is said to have the disadvantage that the message cannot be acknowledged, but in practice this seems to be a minor ailment of the system. Some systems (though not that at the London) avoid awkward moments, the message is only given if the set is switched on by its owner—who may, if he prefers, take the message later by telephone. The system has wide scope. For example, at the Maida Vale Hospital for Nervous Diseases, the night porter is no longer bound to the door or switchboard, for the bells of both operate the receiver which he carries with him. At another hospital, receivers are hung on a rack when the owner is out: this switches on a light at the transmitter, and therefore serves as a most efficient IN-OUT indicator.

It is interesting to quote a few figures. At a London teaching hospital, the average delay per call has been reduced from 2.36 minutes to 54 seconds and the number of frustrated calls has been reduced from 23 per cent to only 5 per cent.

At St, Thomas' it is common practice for the doctor called to ring back within 15 seconds; formerly, delays of 15 minutes were common. The system is in fact, an outstanding success.

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Acknowledgments

The Editor would like to thank in particular Mr. R. P. MacMahon, Deputy House Governor at the Westminster Hospital, and also the Secretaries of the following hospitals or hospital groups for their help in supplying the information which made this survey and article possible: St. Thomas's Hospital, The London Hospital, Guy's Hospital, The Middlesex Hospital, Reading and District Hospital Management Committee, the United Cambridge Hospitals, the United Bristol Hospitals, the United Oxford Hospitals, the United Birmingham Hospitals, Manchester Royal Infirmary, and the Royal Infirmary of Edinburgh.

EDITOR

Letters to the Editor

CUTS BY THE SCORE

A Job Methods Man reports on a visit to the Royal Festival Hall.

Sir,

For considerable periods the four oboe players had nothing to do. The numbers should be reduced, and the work spread more evenly over the whole of the concert, thus eliminating peaks of activity.

All the twelve first violins were playing identical notes. This seems unnecessary duplication. The staff of this section should be drastically cut; if a large volume of sound is required, it could be obtained by means of electronic amplifier apparatus.

Much effort was absorbed in the playing of demi-semi-quavers. This seems an excessive refinement. It is recommended that all notes should be rounded up to the nearest semi-quaver. If this were done, it would be possible to use trainee and lower grade operatives more extensively.

There seems to be too much repetition of some musical passages. Scores should be drastically pruned. No useful purpose is served by repeating on the horns a passage which has already been handled by the strings. It is estimated that if all redundant passages were eliminated, the whole concert time of two hours could be reduced to twenty minutes, and there would be no need for an interval.

The Conductor agrees generally with these recommendations, but expresses the opinion that there might be some falling-off in box office receipts. In that unlikely event, it should be possible to close sections of the auditorium entirely, with a consequential saving of overhead expenses—lighting, attendants, and so on.

If the worst came to the worst, the whole thing could be abandoned, and the public could go to the Albert Hall instead.

S. Tone-Deaf

A UNIQUE OCCASION

Dear Sir,

It was good to see your illustration of the first inspection of the R.A.M.C. by a President of the Royal College of Surgeons. It recalled a memory of 1916 when, at Bart's, we had a medical detachment of the University of London O.T.C. Our training took place in the General Post Office yard and at a summer camp at Codford St. Mary. One had to be on the alert when "forming fours" under the eagle eye of Sergeant J. Ross.

12 Barnfield Hill,
Exeter.
13th November, 1959.

Yours faithfully,
NORMAN CAPENER.

THE APHORISMS OF COZENS BAILEY

Sir,

A month or two ago I was reminding G. Bourne of some of the aphorisms with which Mr. Cozens Bailey used to embellish his surgical teaching, and he suggested that I should offer them to you for the Journal.

I was Bailey's H.S.—somewhere about 1912—and collected and stored up these "sayings". Each was usually prefaced by "What I always say is . . ."

I enclose them with this letter.

Yours sincerely,
A. B. PAVEY-SMITH.

"What I always say is . . . "

Carcinoma of the breast has no symptoms.

Tubercle will appear wherever there are blood vessels—and in some places where there aren't.

All is not fluid that fluctuates.

Every breast operation takes years off your life.

Once a stricture always a stricture—and when you think it's cured you must always remember that it isn't.

If the "facts" don't fit the case so much the worse for the "facts".

If you don't like comparing surgical things to articles of diet then you'd better give up Surgery.

If you suspect a man of having syphilis don't *listen* to his tongue—*look* at it.

SPORTS CLUB TOURS

To the Editor,
St. Bartholomew's Hospital Journal.

Sir,—We understand from usually reliable sources that the rugger club spent something in the region of £130 on their recent tour in the West-country. During the course of their five night tour the club played three matches, lost three matches and gained only six points.

Discussion of this matter with a member of the team elicited the information that the team put up with a 10s. 6d. bed and breakfast, drank less than usual and behaved more quietly than usual in order to try and leave a more favourable impression in their wake than they have managed to do in recent years. All this we think is very laudable. We were also told that the team contributed £4 each to the expenses—why then did it cost the Students' Union £130 (which incidently we, collectively, provided)? One reason must be the high cost of transporting twenty-two men to the West-country.

Why do the team go to the Westcountry? Some say it is tradition, others say it is because all the other hospitals send teams there—neither reason is good enough. Others say it is to take the good name of Bart's into these remoter parts. We doubt if the Rugger Club are our best ambassadors and in any case we suggest they stay nearer at home and try to consolidate the work done for the hospitals good name by the successful tours of the Cricket and Soccer Clubs. These two clubs went to Sussex and Cambridge at a cost to the Students' Union of £50 and £24 respectively.

We remain Sir,
Yours faithfully,
THE SPHEROIDS.

The Abernethian Room,
St. Bartholomew's Hospital.

Book Reviews

THE COMPARATIVE ANATOMY AND PHYSIOLOGY OF THE NOSE AND PARANASAL SINUSES
by Sir Victor Negus
pp. 402, figs. 178. Published by E. and S. Livingstone. Price 70s.

This book, which embodies the patient and careful research over the last twenty years, brings together the original work of the author upon nasal anatomy, morphology and physiology of the upper respiratory tract. Although it is primarily concerned with the nose and the accessory sinuses, it recapitulates much previously published work on the larynx.

Finely produced and lavishly illustrated, it is a tribute to the immense breadth and depth of the author's knowledge and interest in what has seemed to others an unrewarding field. He illustrates his thesis from the whole range of the animal kingdom and leaves us with a higher regard for this humble organ that carries out its many and complicated functions with such ingenuity that few

of us, fortunately perhaps, are aware of them. Here too is the basis of treatment by restoring the anatomy and function to normal.

The book commences with an essay on the adaptations of the nose for olfaction ; the mechanisms of air conditioning and fluid exchange are clearly analysed. There are particularly good sections upon ciliary activity and the organ of Jacobsen. On the debit side the anatomy and morphology of the soft palate and naso-pharyngeal sphincter, and the electrophsyiology and neurology of the smell brain have been considered to lie outside the scope of the book.

Sir Victor Negus anticipates some criticisms of his interpretation of observed facts when he quotes Professor Le Gros Clark, who remarked 'it is a mistake to wait for absolute proof for fear of beng accused later of inaccuracy, with denigration'. It is certain that many will challenge him on both fact and conclusion, but none will deny his authority as doyen in this field.

DOCTORS COMMONS

by Paul Vaughan

William Heinemann - p. xvi and 254 - Price 18s.

It is doubtful if even the far-sighted Dr. Charles Hastings anticipated in 1832 how his Provincial Medical and Surgical Association, founded to oppose the powerful conservative interests of Medicine in London, would develop into the B.M.A. as we know it today, with 71,000 members drawn from every section of the British Medical profession.

There are too many misapprehensions in the public mind as to the nature of the B.M.A. It is not, as the author specifically points out, a Trade Union and any such idea is precluded by its own Constitution. Nor is it the place where doctors take the Hippocratic oath or a body constituted to discipline the profession.

But if the public is ignorant so too are the majority of those who are in or who hope to enter the profession. How many of us are familiar, even en passant, with the details of the Association's fight for Medical Reform which culminated in the Act of 1858, or with the struggles to reform the Poor Law Medical Service and the Army Medical Service.

The details of the ineptitudes of both government and military authorities, with regard to the care of the sick and wounded, even in the light of the Crimean campaign, appal the reader. It was not until the Franco-Prussian War that we were shown how such matters should be handled, and the R.A.M.C. was founded only sixteen years before the First World War. Imagine the Western Front had we not seen the light in time.

These matters together with the development of the B.M.J., the "Lloyd George", the inception of the N.H.S. and many other topics are dealt with by Mr. Vaughan in a light and easy style. This is a "short history" and all irrelevant detail is discarded leaving us with a clear general picture in which are set cameos of the personalities who did so much to shape the successful development of the B.M.A. into what has been described as "one of the most highly developed and efficient of all British professional organisations". This is a book that all should read.

A.J.B.M.

DR. JENNER OF BERKELEY

By Dorothy Fisk

Heinemann 1959 - 288pp. - 25s.

Few publishers will undertake the risk of issuing serious biographies of medical men, and it has become necessary to dress up for popular consumption this type of literature in order to secure its financial success. No harm is done if the facts are authentic ; on the contrary, the general public can benefit from an appreciation of the trials, tribulations and triumphs of eminent men.

Edward Jenner (1749-1823) has been the subject of several biographical studies, the most outstanding recent contribution being Mr. W. R. LeFanu's Bio-bibliography of Edward Jenner published in 1951. Quoted by Dorothy Fisk as the most important of her sources, it might well have served as an example of a well-documented piece of research. Her own list of sources contains only two dated items, and the index not only flaunts most rules of indexing, but is not even alpthabetical !

The story of the development of methods used to combat smallpox is intricate, and the literature on the subject is enormous. Following closely upon the publication of Jenner's Inquiry, for example, there was a spate of books and pamphlets by both supporters and opponents of vaccination, and we still have literature published devoted to the pros and cons of the subject. It is impossible for anyone, a layman in particular, to assess the value of many of these early writings because their authors quite frequently did not themselves fully appreciate Jenner's methods. Some of his keenest supporters were in fact hindrances rather than helps in furthering his object. Laymen will still fail to appreciate the difference between inoculation and vaccination ; they will also find neither of these terms in the index to this book.

The background material for Dorothy Fisk's' biography has obviously been collected as the result of much labour, but it tends at times to obscure the figure of Jenner. There are so many other characters mentioned, so many events recorded that it is difficult to obtain a clear picture of the person named in the title. We obtain glimpses of the typical country practitioner, lover of the countryside, keen naturalist and observer who spent large sums of money on publicising vaccination. It was in an attempt to recoup his losses that he was persuaded to come to London, but he must have been as out of place there as a lamb among hungry wolves. His early return to Berkeley where everybody was an undisguised friend was necessary for his survival.

The general public with a leaning towards this type of literature will read this book with pleasure and profit. It lacks the sensationalism of certain similar writings, but will interest the careful plodder who expects nothing sufficiently well documented as to permit the term scholarly.

JOHN L. THORNTON.

Extracorporeal Circulation

by R. L. HURT
(*Research Assistant*)

A report of the experimental use of a Gaertner-Kay artificial heart-lung machine at St. Bartholomew's Hospital

For many years it has been recognised that the successful treatment of many forms of congenital and acquired heart disease would require some method of operating on the open heart under direct vision in a dry field. In the United Kingdom each year there are born approximately 3,000 infants with congenital heart disease. Excluding cases of patent ductus arteriosus and coarctation of the aorta, about half of those infants who survive the first year of life have defects that are amenable to corrective surgery. Some of these operations can be performed by a "closed" technique but the majority are better done by an "open" operation which is made possible by using a machine to take over the function of the heart and lungs. As further experience in the use of these machines is gained it is certain that they will also be used increasingly for cases of acquired heart disease, such as aortic stenosis, mitral stenosis with calcification, or mitral regurgitation.

The use of hypothermia, in which the patient is cooled to 30 deg.C, allows the circulation to be interrupted for about 9 minutes. This provides sufficient time for certain abnormalities such as the secundum type of atrial septal defect or pulmonary stenosis to be corrected. Other abnormalities such as ventricular septal defect, tetralogy of Fallot, or the primum type of atrial septal defect, are more complicated and require a longer time for operation. It is for such cases as these that some form of artificial heart-lung machine is essential. The machine maintains the systemic blood flow (including in particular the cerebral circulation), and allows the operation to be performed carefully and without haste. In addition there is no fixed time limit within which the operation must be performed and this is of great psychological importance to the surgeon, who may always encounter an unexpected abnormality within the heart, or an unexpected difficulty in the surgical procedure.

The use of a heart-lung machine does not allow an unlimited time for operation, since all types of machine damage the blood to some extent, depending on the principle upon which they work. The majority of pumps and some methods of oxygenation traumatise the blood by fragmenting the red cells, removing fibrinogen and platelets, and liberating haemolysins. This leads to difficulties in blood coagulation at the conclusion of the operation. In the early days of heart-lung machines many of the experimental animals died of haemorrhage because this problem was not fully understood and adequate precautions were not taken to minimise blood damage.

Recently Drew at the Westminster Hospital has been developing a new technique of profound hypothermia in which the patient's temperature is reduced to 15 deg. C, two pumps being used to support the heart during the cooling process. At this temperature operations on the open heart lasting as long as one hour have been successfully performed but the method is new and its full value has yet to be assessed.

Much of the pioneer work on pump-oxygenators has been done in the United States. To Gibbon, who published his first paper on this subject in 1939, must go the credit for using a heart-lung machine for the first time in man. In 1953 he successfully repaired an atrial septal defect, using a machine that has since been modified and used with great success by Kirklin at the Mayo Clinic on several hundred patients. In the same year Andreason, working in England at the Royal College of Surgeons, showed that dogs would survive complete occlusion of both venae cavae for 30 minutes, providing blood was allowed to return to the heart via the azygos vein. The circulation was therefore maintained entirely on this so-called azygos flow, which is about 10 per cent of the normal cardiac output. As life could be maintained on such a small flow, cross circulation experiments were performed, using a second dog as a "heart-lung machine". This work was repeated by Lillehei at Minneapolis and ventricular septal defects were successfully repaired in children using an adult human donor for cross circulation. However, this technique involved too great a risk for the donor and was abandoned. It was replaced

by a low-output heart-lung machine, thus still using the low-flow principle. Experience showed that these low-flows had grave disadvantages and consequently great efforts were made to design a machine that would provide an output equal to the normal systemic flow at rest. In England, Melrose spent several years developing a machine of this type and it is now used routinely on patients at the Hammersmith Hospital, London and at Stanford University Hospital, San Francisco. There is no doubt that the Melrose machine in its latest form is most satisfactory.

Types of heart-lung machine

Certain basic principles govern all types of heart-lung machine. The venous return to the heart is diverted through large cannulae introduced into the superior and inferior venae cavae via the right atrium. This blood passes to the machine by gravity through a large bore tube into a reservoir situated about 12 inches below the patient. The blood after passing through an oxygenator is pumped back into the patient through a cannula tied into the femoral artery, the cannula being directed centrally so that the blood runs into the aorta and thence to the rest of the body. There is a fine mesh filter in the arterial line, so as to prevent fibrin emboli entering the circulation. All types of machine permit control of the output of arterial blood and also the volume of blood in the machine. Some form of heating device is usually incorporated so as to maintain the blood and body temperature. It is highly desirable that all parts of the machine that are in contact with the blood may be easily sterilised and cleaned.

One of the main problems in heart-lung machines has been to develop an adequate lung mechanism. It is necessary to add oxygen and remove carbon dioxide from a large volume of blood—up to 4 or more litres a minute when operating on an adult. The blood must be exposed to the gas atmosphere as a very thin film — no more than half a millimetre thick and preferably less. This means that the artificial lung must spread the blood over an area of 2-10 square metres, expose this film to an atmosphere of oxygen under sterile conditions, and collect the oxy-

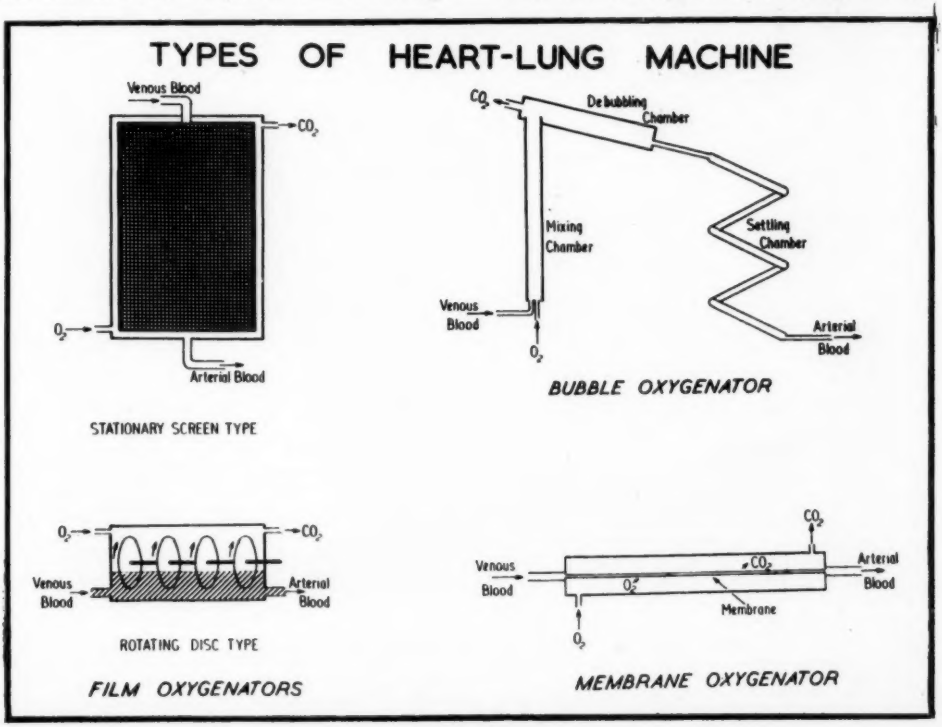


Fig. 1.

genated blood ready for pumping back into the patient.

Special precautions must be taken to reduce to a minimum the damage to the blood during its extracorporeal circulation. Plastic tubing is used throughout as this causes minimal adherence of platelets to its internal surface and hence minimal loss of coagulability of the blood. The stainless steel connecting pieces are tapered so as to avoid eddies in the flow of blood, and all the surfaces are highly polished and kept as scratch free as possible. It is especially important to use a pump that does not injure the blood; for this reason a roller type of pump which gently compresses the tubing containing the blood is often employed.

There are three types of artificial heart-lung machines that are at present in use (Fig. 1):

(1) Bubble oxygenator;
(2) Film oxygenator;
(3) Membrane oxygenator.

Bubble oxygenator: In this machine which has been developed by the Lillehei-DeWall group at Minneapolis, blood and oxygen enter the bottom of a long vertical tube. The blood is converted into foam, which then passes into a defoaming chamber where it is converted into a nearly bubble-free state by contact with a substance that lowers its surface tension. This blood then passes into a coiled settling tube in the form of a helix where any remaining bubbles are able to separate. The oxygenation in this machine is very good, but the output of oxygenated blood is relatively small and is limited by the time interval necessary for the blood to be made completely bubble-free. This machine was designed on the "low flow" principle but

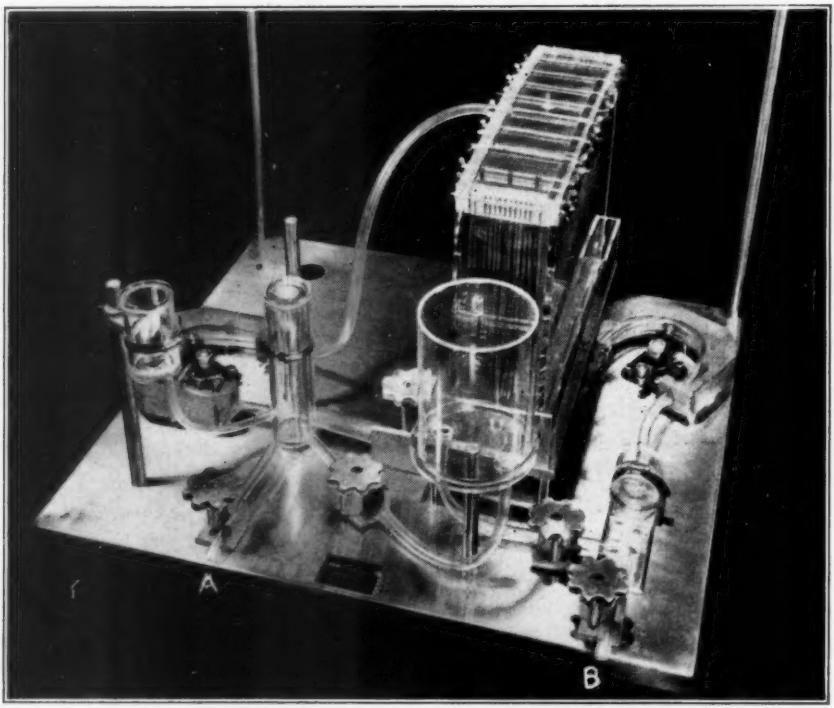


Fig. 2. *General view of the Gaertner-Kay heart–lung machine*

On the left can be seen the recirculating pump and on the right the arterial pump. In the centre is the perspex oxygenator case containing the vertical stainless steel screens, and to the left of the oxygenator is the venous reservoir. In front of the arterial pump is a filter. Blood from the venae cavae enters at A and arterial blood leaves the machine at B.

recent models are able to provide a flow of about 3 litres a minute, though this is still below the normal resting circulatory level for an adult. The machine, apart from the pumps, is made entirely of plastic tubing. Since fresh tubing is used for each operation, it is not necessary to clean the machine after use, whereas oxygenators of a non-disposable type require meticulous cleansing, a most-time-consuming procedure. The machine is relatively cheap, costing about £700. The priming volume is reasonable, 2-4 pints being required depending on the rate of flow. However, it is being superseded by other machines that can produce a higher and more physiological flow of oxygenated blood.

Film oxygenator: The blood is spread out as a very thin film in an atmosphere of oxygen, thus allowing the oxygen and carbon dioxide exchange to occur. There are two types of film oxygenator—the stationary screen oxygenator and the rotating disc oxygenator. In the stationary screen oxygenator, of which the machine used at the Mayo Clinic is an example, the blood runs down a series of stainless steel gauze screens, each of which is 18 inches long and 12 inches wide. These screens are enclosed in a perspex case, through which a mixture of 97½ per cent oxygen and 2½ per cent carbon dioxide is passed. The oxygenated blood is pumped out of the base of the container by an arterial pump. In the disc oxygenator the blood is picked up as a thin film on a series of rotating stainless steel discs. This type of apparatus was first developed by Björk in Sweden. The same principle has been used by Melrose in the highly successful machine now being used clinically at the Hammersmith Hospital.

Membrane oxygenator: In this oxygenator, which attempts to imitate the lung more closely than does any other machine, the blood is separated from the oxygen by an exceedingly thin plastic membrane, through which the oxygen and carbon dioxide diffuse. Clowes, working in Cleveland, has developed this type of oxygenator but it has proved difficult to make it reasonably compact and easy to sterilise. Thomas in Paris has also developed an apparatus working on this principle and has used it successfully on many human patients.

Gaertner-Kay machine

A simplified version of the stationary screen oxygenator that is in clinical use at the Mayo Clinic has been used experimentally on dogs at St. Bartholomew's Hospital. The Mayo Clinic machine is a complicated piece of apparatus costing about £15,000; much of its expense is due to its numerous electronic monitoring and safety devices. The simpler machine (Fig. 2) was designed by Dr. Gaertner and Dr. Kay working at the National Heart Institute in Bethesda, America. It is made of perspex and has 5 or more stainless steel mesh screens, each 10 inches long and 16 inches wide. There are two rotary (DeBakey) pumps; one to pump blood to the top of the oxygenator and the other to pump the blood back into the patient. The tubing is made of polyvinyl chloride, a plastic that is less harmful to the blood than is rubber. There are no electronic safety devices. About 5 pints of blood are required to prime the machine. The circulation of blood through the machine is shown in Fig. 3. The venous blood enters a reservoir and is then pumped to the top of the oxygenator. It is oxygenated as it runs down the stainless steel screens and is then returned to the venous reservoir. There is thus a continuous circuit of blood round the oxygenator. Into this circuit runs venous blood from the animal, and oxygenated blood is pumped from the base of the oxygenator back into the femoral artery and so to the rest of the body.

Fig. 4 shows how the machine is connected up to the experimental animal. Through a right thoracotomy, the heart is exposed and two catheters are introduced into the heart via the right atrial appendage, one into the superior vena cava and one into the inferior vena cava. At the time of bypass, slings placed around the cavae and the contained catheters are drawn up so that all the blood returning to the heart, except the coronary return, flows through these catheters and then by gravity into the venous side of the machine. The blood is oxygenated at it passes down the stainless steel screens and is then pumped back into the dog through the femoral artery. The dog is heparinised before the catheters are inserted; at the conclusion of the bypass, the heparin is neutralised with an appropriate dose of protamine.

During the whole operation, including the actual bypass, a continuous record is taken of the arterial pressure, venous pressure, electrocardiogram, and electroencephalogram. The temperature is also recorded as it will fall considerably during the bypass if the blood in the machine is not warmed.

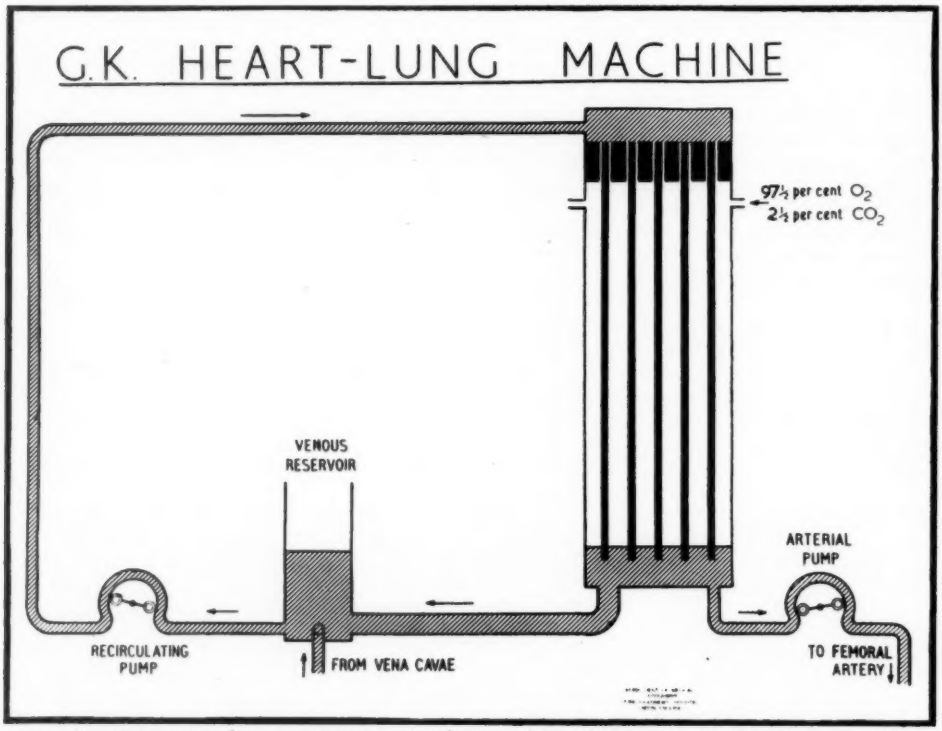


Fig. 3. *Schematic diagram showing circulation of blood through the heart-lung machine*

As soon as the heart-lung bypass is running smoothly, the heart is stopped with potassium, using the method developed by Melrose (Fig. 4). The ascending aorta is clamped distal to the origin of the coronary arteries and 2.5 per cent potassium citrate is injected into the root of the aorta. The potassium solution enters the coronary arteries and the heart stops in diastole. The motionless heart may then be opened, and since there is no coronary flow, the heart is absolutely dry. The heart is started again by releasing the aortic clamp and allowing the potassium to be washed out of the myocardium by the blood pumped up the aorta from the machine. Care has to be taken at this stage that the heart does not become distended, as the coronary flow is enormously increased due to the effect of the potassium on the capillary bed. A sucker placed inside the right ventricle before it has been finally closed is used to aspirate blood from the right side of the heart and prevent any distension occurring. This blood is automatically returned to the machine. It may also be necessary to release one of the caval slings and allow some of the large coronary flow to return through the cava to the artificial circulation. Ventricular fibrillation will occur in about 20 per cent of cases, but the heart may be easily defibrillated electrically and a normal heart-beat then follows.

Results of experimental work

Before a heart-lung machine can be used successfully on human beings, a period of laboratory work is necessary so that the machine can be made to work properly, so that the technique of perfusion and of going on and coming off bypass, may be worked out, and so that the personnel involved in such an operation, the surgeon, anaesthetist, physiologist and pump operator, may become used to working together as a team. The experimental animal work began early in 1958 and the "G.K." machine has been used to bypass a dog's heart in 80 operations. For the first few months the dogs died with monotonous regularity and there was considerable trouble with foaming of blood in the

machine, and later, when this foaming had been eliminated, with poor oxygenation. The arterial oxygen saturation fell to 80 per cent or less even at relatively low flows within 15 minutes of the commencement of the bypass. By making major modifications in the oxygenator, the foaming of blood was eliminated and the oxygenation was improved. In the summer of 1958 a few dogs began to survive, and then during October six consecutive dogs survived successfully a bypass of thirty or more minutes and made complete recoveries.

Unfortunately it has proved impossible to make this machine work sufficiently well for human use and this has been the experience at many other centres where this type of apparatus has been used. By using 9 screens it was possible to obtain an output of 1,600 ccs. per minute, this being just sufficient for a dog weighing 16 Kg. The oxygen saturation of this blood was only about 80-85 per cent however, and if any higher flow rate was used, the oxygenation fell precipitously. The priming volume for the machine containing 9 screens was 5 pints. The efficiency of the machine could have been improved by rebuilding the oxygenator, and increasing the number of screens, but this would of necessity have meant increasing the priming volume of the machine, which was already large. It was therefore decided that we were not justified in using the machine for human cases. In its place a Melrose type of heart-lung machine has been purchased and this has been used in the animal laboratory during the last few months with complete success. The machine is now in clinical use at Hill End Hospital, St. Albans.

Results of open-heart surgery

There is no doubt that open-heart surgery is now a safe procedure with the use of a heart-lung machine. It has provided the means whereby many forms of congenital and acquired heart disease may be treated satisfactorily. The work of Kirklin, Lillehei and Cooley in America and Cleland in this country, shows that the results of the closure of ventricular septal defect in the absence of severe pulmonary hypertension are very good. Operation for cases of tetralogy of Fallot is less satisfactory and the mortality is higher. On the other hand, operation for aortic stenosis, both congenital and acquired, is now best performed under direct vision with the use of a heart-lung machine. It is certain that the scope of open heart surgery will increase rapidly during the next few years.

Conclusion

The successful management of extracorporeal circulation demands skilled team work, much complex recording equipment, and great attention to a host of details. The establishment of a heart-lung team is a considerable undertaking and requires a prolonged period of laboratory work. The animal surgery has been carried out by Mr. O. S. Tubbs, Mr. I. M. Hill, Mr. P. R. Slade and Mr. E. Shocket. Dr. B. G. Wells has been responsible for the electromanometry and other recording apparatus and has given a great deal of help in other ways. Dr. Mendel has been invaluable with physiological and technical advice and Doctors Keil, Langdon and Young have given up a great deal of their time to provide anaesthesia. Dr. Story has done all of the numerous haematological

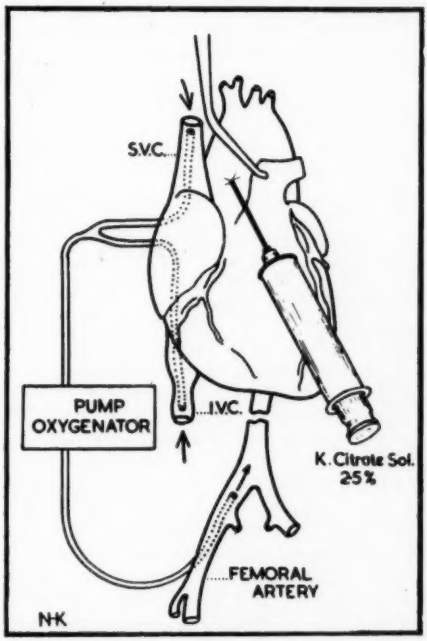


Fig. 4. *Method of potassium arrest*

Potassium citrate is injected proximal to a clamp placed across the aortic arch. The potassium enters the coronary circulation and the heart stops. This diagram also shows the method of connecting the heart-lung machine to the experimental animal

studies and the thoracic unit theatre sister, Miss Mason, has come up to London from St. Albans for almost every animal operation and has been quite indispensable. The physics workshop, under Mr. Crichton, has been most patient with the repeated requests for technical work.

My thanks are due to Mr. O. S. Tubbs for his helpful criticism of this article; and to Mr. N. K. Harrison for the illustrations.

HISTORICAL DIAGNOSIS

Lucan, in Book IX of his poem Pharsalia, otherwise entitled The Dramatic Episodes of the Civil War, describes the peculiar manner of the death of two of Cato's legionaries during their march through Libya in February of 46 B.C.

Of one, ' . . . The bite was not painful and the wound seemed harmless enough but the hidden venom began to boil, and a devouring flame spread through the marrow of his bones, drying up the moisture which surrounded his vital organs, and the saliva that kept his tongue wet, and the sweat in his pores, and the very tears in his eyes.'

The account goes on to describe how the patient felt as though he was on fire, and 'rushed about madly in the quest of the water for which his heart craved'.

Of the other, ' . . . The skin next to the bite began to break down, and the flesh to melt away until the white thigh-bone showed ; then, as the wound widened farther, the body swam in corruption and slowly disappeared, starting with the calves, knees, and thighs. Black matter dripped from the thighs, the muscles that held the belly in place snapped and the guts slid out. S., in fact, slowly trickled into the ground, and there was unexpectedly little left of him, for he was a big man.

'His anatomy was for a while revealed with painful clearness: ligaments, sinews, the structure of the lungs, the bones of the chest, and all the inner organs.' A.M.W.

SUGGESTIONS PLEASE!

Sports News

VIEWPOINT

Recently, in the National Press, there has been more than a little discussion about the relative positions of amateurs and professionals in the world of sport. Perhaps one of the more interesting points has been concerning the Rugby Football Union. Unlike its professional counterpart in the North, its clubs are entirely free to play whom they like. and the results of any matches played are relatively unimportant. There have been recent suggestions that Union clubs should run on the same lines as the Rugby League, and that they should actually be formed into Leagues. The reaction to such a suggestion is on the whole one of horror, particularly from the Union clubs themselves, and one can but agree with their sentiments. There are, of course, points for and against such a scheme. No doubt one or two people may be persuaded to visit Chislehurst occasionally, particularly if the Hospital Rugger Team was fighting for promotion to Division I, for instance. But once such a spirit enters amateur sport, particularly Rugby, then the whole point of the game which, to use the often coined remark that it is the enjoyment of a game rather than the result that matters, is lost.

Results in sporting activities of the Hospital this season, with the notable exception of the Ladies' Hockey Club, are so far rather disastrous. Let us hope that this is merely a passing phase, and that perhaps after Christmas an occasional victory may be seen.

★ ★ ★

MENS' HOCKEY CLUB

Cambridge Tour, October 29th-31st

Results:
v. King's College Drawn 4—4.
v. Jesus College Lost 2—3.
v. Queens' College Lost 3—5.

Although the results suggest otherwise, the annual Cambridge Tour was a great success. For the first time in the season the 1st XI showed their potentialities with some constructive play against teams with well-drilled defences and cunning attacks. The three matches as a result were of a high standard and very enjoyable.

The first match against King's College was played in perfect conditions. Bart's soon settled down to playing a steady and forceful game. The half line did noble work in defending the mid-field and on several occasions sent up some fine passes to the wing forwards which R. Jeffreys on the left used with great effect. Our opponents, however, were always ready to make the most of the few mistakes our defences made and managed to lead 3-1 at half-time. The second half became a desperately fought affair, each forward line breaking away but our defence consistently filled the gaps. Before long, with some short passing among the forwards—a goal from B. Holland in the centre, and an incredible goal from H. Walker who took the ball on the right almost to the line, shooting at a seemingly impossible angle—our opponents lead was cut to 3—4.

After several more attacks the equaliser was scored and in the last ten minutes each side in vain fought for a decisive goal.

The match on Friday was against Jesus College. There had been heavy rain overnight and in consequence the ground was fairly slippery. But this did not prevent some very fast play. Bart's drew first blood catching their opponents before they had settled down. But as soon as they had they were swinging the ball from one wing to the other showing their paces as a practiced team. In defence, our backs, H. DaSilva and D. Goodwin proved very reliable and were only beaten by fine forward moves and quick passing. Several times Bart's were beaten to the loose ball and their semi-accurate passes intercepted. The forwards had many attacks cut short by a solid opposing defence. The second half, starting with the score 2—1 down, was an almost constant struggle for the Bart's defence who did noble work in getting the ball up to the forwards on many occasions. But the task made Bart's weary and the Jesus forward line pressed home another goal.

As a last effort Bart's scored off a short corner taken by H. Walker making the final score 2—3.

Our final game, on Saturday, was, as expected, our toughest, for the Queens' College team, we had been warned, was one of the best college sides. The pattern of the match was similar to that of the previous day with Queens' clearly taking the upper hand. Their passing was exemplary and their stickwork confusing. But they certainly did not have it all their own way. Bart's rose to the occasion intercepting many of their midfield passes and using the wings mainly the left with some success. Three-one down at half-time, the second half produced some very hard play usually ending in short corners. Bart's managed to put two goals in, one from a corner, in answer to a cracking goal from the Queens' right inside forward. And to make it quite certain they soon had another in making the final score 3—5.

The tour was a great success showing the team its potentialities and providing three really enjoyable games, quite apart from (unreported) social activities, and the warm hospitality of the three colleges.

The teams were chosen from: A. J. Gordon (capt.); H. DaSilva, D. Godwin, A. Frank, A. Robertson, D. S. Wright, H. R. J. Walker, P. W. Caine, P. A. Bennett, R. Jeffreys, B. Holland, D. N. C. Glover, A. Chant.

LADIES' HOCKEY CLUB
Cambridge Tour

v. Magdalene Rugger Club, Friday, October 30th. Bart's won 2—1

This was a most entertaining game of somewhat unorthodox hockey. Our opponents, in bizarre uniform, towered above us. Nevertheless we managed to keep them fairly well at bay. At half-time Magdalene had scored once. Soon afterwards Bart's equalised and scored a second goal a few minutes before the final whistle, and though Magdalene tried valiantly to score again, they were unable to do so leaving us with a rather surprising victory.

v. Cambridge University 2nd XI. Saturday, October 31. Bart's won 5—2.

After our severe defeat last time by the first XI, we elected this year to play the 2nd XI and found the teams better matched. Unfortunately our opponents were short of a goalkeeper, although this hampered us, too, as it made the offside rule more difficult to observe. The result after a good game was a win for the hospital by five goals to two.

v. Queens' College 1st Hockey XI, Sunday, November 1st. Bart's won 3—2.

Our opponents began the day by entertaining us to sherry before lunch. Once on the field they toyed with us for most of the first half. In the second half we contrived to score three goals and Queens' did not leave themselves quite enough time to catch up. Once more we were surprised to find ourselves the victors. Queens' again proved themselves to be excellent hosts and we spent an entertaining evening in the college.

v. Homerton Training College, Monday, November 2nd. Drawn 4—4.

This was the final match of the tour and the two teams were well matched.The game was a fast one and the result a fair indication of play on both sides. Thus our tour came to a most successful conclusion. It was an enjoyable one, and our thanks are due to all our hosts in Cambridge for their hospitality to us.

The members of the team were: C. Lloyd, J. Tuft, T.Coates, P. Kielty, M. Childe, M. Robertson, S. Cotton, G. Green, J. Swallow, S. Minns, J. Hartley, E. Knight.

SOCCER
Cambridge Tour

The annual tour of Cambridge is always looked forward to mainly because of the prospect of good games and excellent hospitality. This year was no exception when in addition, the revelries of November 5th and Poppy Day were also enjoyed. Particularly memorable was the sight of a poppy seller in the hotel trying to sell his wares to pyjama-clad Bart's players at 8.30 a.m., and the look on a certain member's face when he thought he had broken the hotel's television set. From the football point of view we won one game and lost the other but the showing of the team was good and it is hoped that this tour will mark the turning point in what has so far been a bad season.

Bart's v. King's College, Thursday November 5th. Won 2—0

In ideal conditions Bart's kicked off and started to produce some good football, a pleasing change from the previous match. The forward line combined well and many passing movements which previously had got no further than the training sessions began to emerge. Was it because Prosser had vacated his usual defensive place and moved into the forward line? Well, Prosser thinks so! In spite of all our attacking there was no score before half-time, many power-drives by Prosser going just wide. Turning round, Bart's still kept the initative and were rewarded by the best goal seen this season. Phillips, surrounded by King's defenders drove the ball first time into the top right hand corner of the net. Another goal soon followed when a cross from the left, after being fingered, passed Hore's head by the King's goalie and was banged in by Savage. After this Bart's fell on the defensive as King's pressed our goal, but the defence stood firm until the final whistle.

Team: J. Davies, G. Haig, F. Amponsah, J. Jailler, R. Kennedy, B. Perriss, P. Savage, H. Phillips, B. Hore, D. Prosser, M. Noble.

Bart's v. Trinity Hall. Friday 6th November, Lost2—3.

On a fine plush pitch, Bart's came up against a better team than the previous day, the Hall's fast moving forwards bringing havoc to the Bart's defence. It was not surprising then that Trinity Hall soon scored and quickly followed this with another goal, which was however unluckily disallowed. Little was seen of the Bart's forwards at this stage of the game while Trinity Hall added to their score before half-time. In the second half Bart's showed some fight and reduced the arrears when Haig bore down on the Hall's goalie knocking the ball out of his hand and tapping it into the net. However Trinity Hall increased their lead when Davies misjudged a high lob. Bart's continued attacking, a fine pass by Savage allowing Phillips to score a relatively simple goal. Trinity Hall playing the better football missed many chances mainly through shooting from too far out so Bart's were lucky to end the day only one goal behind.

Team: J. Davies; G. Haig, F. Amponsah; J. Jailler, R. Kennedy, B. Perris; P. Savage, H. Phillips, M. Waterworth, D. Prosser, M. Noble.

HOSPITALS' LEAGUE
1st XI v. University College Hospital Wed. Nov. 4
Away Lost 0-2

Oh, miserable Bart's! A display as poor as the pitch and the weather. Yet in the opening minutes Bart's pressed hard and produced some good passing movements. But U.C.H. luckily scored when Davies didn't quite collect the ball cleanly while diving, allowing a scrambled goal. The heart seemed to go out of Bart's and U.C.H. were made to look a better side than they really were. In the second half the Bart's goal was almost continually under pressure and another goal was conceded. The game crawled on to its dreary end, the cries of a Bart's supporter from the touchline being of little avail. Since we are due to play U.C.H. in

the Hospital's Cup the result was exceedingly disappointing.

Team: J. Davies; F. Amponsah, D. Prosser; J. Jailler, R. Kennedy, B. Perris; A. Andan, P. Savege, H. Phillips, L. Fregbulum, M. Noble.

Other Results

Sat. Oct. 31.—A.F.A. Junior Cup, 2nd Round—Bart's 1st XI v. Old Edmontonians Reserves. Home Lost 1-2. Scorer: Iregbulum.

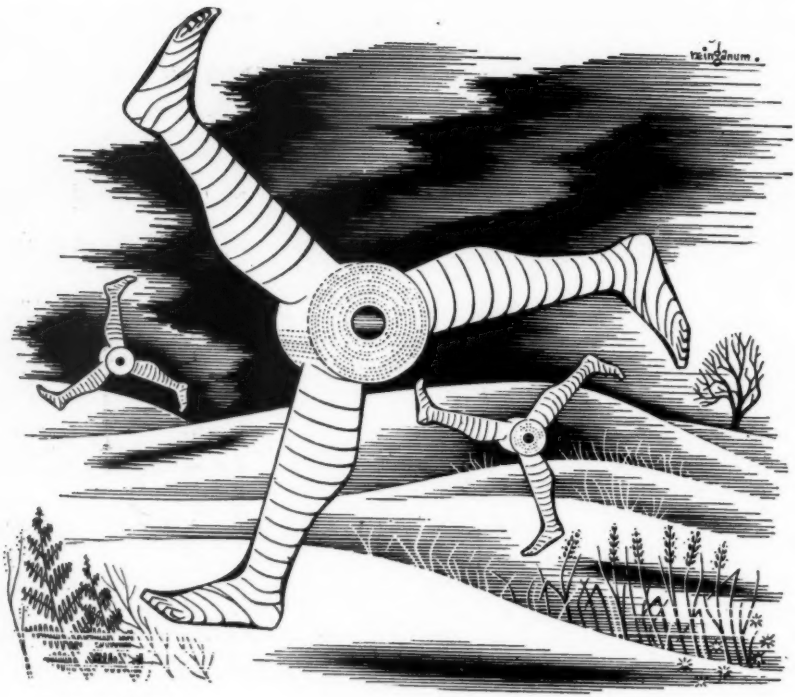
Wed. Nov. 11—St. Bart's 'A' XI v. Normandy Company Sandhurst. Home, Won 3-0. Scorers: Mercer, Perry and Prosser.

TABLE TENNIS CLUB

The officers for this season are A. J. Miller (captain), B. D. Hore (secretary) and B. W. Perris (treasurer).

This season marks the re-entry of the club into the University of London League. A first class table has just been bought and the club meets on Tuesday evenings at 7.30 p.m. The first match was played on November 16 against Goldsmith's College.

Result: Goldsmith's won by 8 matches to 2. As the individual results show the match was by no means as one-sided as the result above suggests. In fact the individual players did well and regular practice on the new table should soon reverse defeats like this. E. Skinebourne playing in his first match showed considerable promise.



AMBULATION...

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